





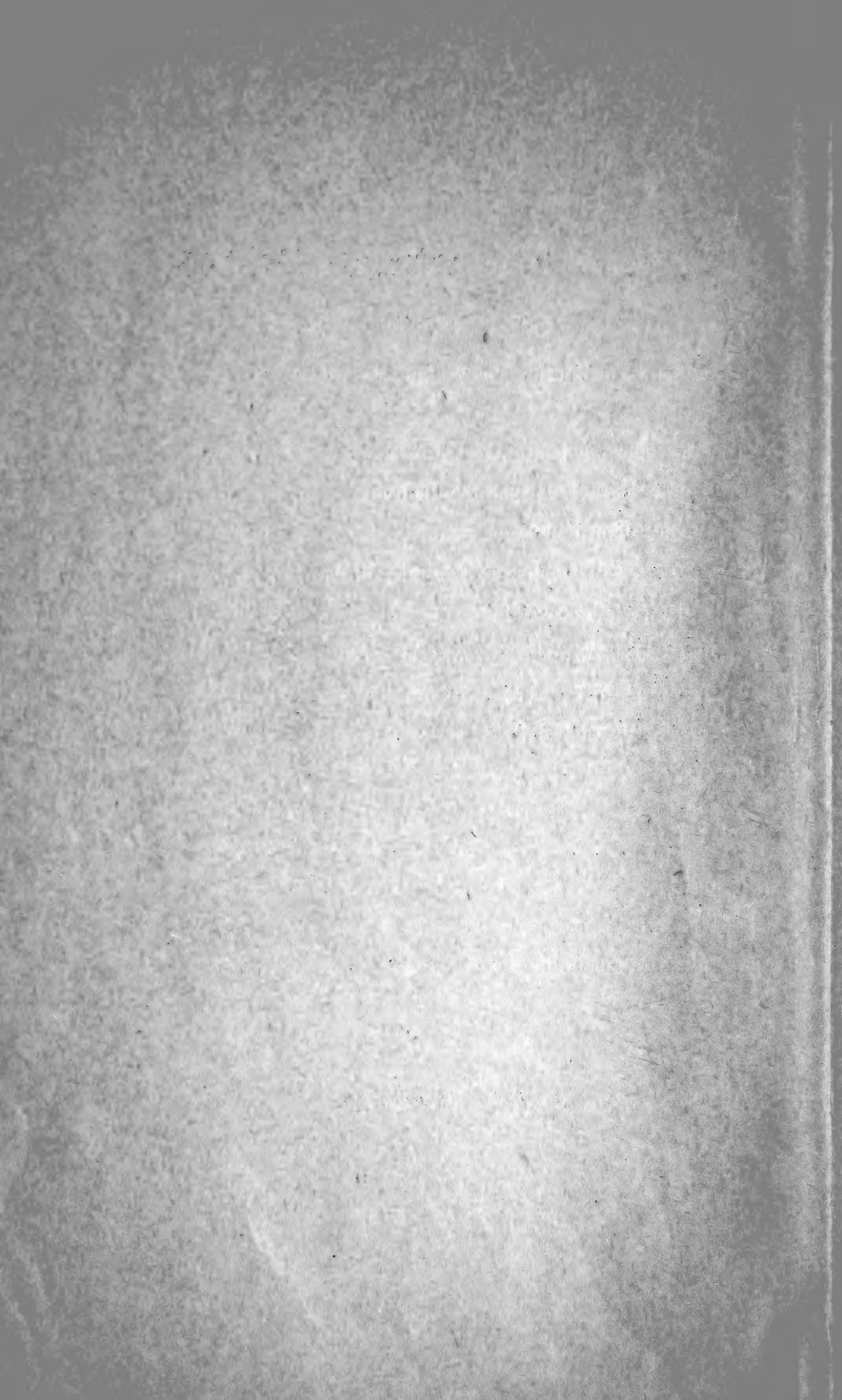
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GENERAL CHAPTERS  
AND  
TAXONOMICAL REVISIONS

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KEMENTERIAN PERTANIAN / MINISTRY OF AGRICULTURE

# FLORA MALESIANA

BEING

*AN ILLUSTRATED SYSTEMATIC ACCOUNT OF THE MALAYSIAN FLORA ,  
INCLUDING KEYS FOR DETERMINATION , DIAGNOSTIC DESCRIPTIONS ,  
REFERENCES TO THE LITERATURE , SYNONYMY , AND DISTRIBUTION ,  
AND NOTES ON THE ECOLOGY OF  
ITS WILD AND COMMONLY CULTIVATED PLANTS*

PUBLISHED

UNDER THE AUSPICES OF THE KEBUN RAYA INDONESIA / BOGOR / JAVA ,  
BOTANIC GARDENS OF INDONESIA / BOGOR (BUITENZORG) AND  
OF THE RIJKSHERBARIUM / LEYDEN / NETHERLANDS

PREPARED

ON AN INTERNATIONAL CO-OPERATIVE BASIS UNDER THE SUPERVISION OF  
SEVERAL DIRECTORS OF BOTANIC GARDENS / KEEPERS OF HERBARIA  
AND VARIOUS PROMINENT BOTANISTS

FOR THE PROMOTION OF  
BOTANICAL SCIENCE AND THE CULTURAL ADVANCEMENT OF  
THE PEOPLES OF SOUTH-EASTERN ASIA TO  
THE SOUTHWEST PACIFIC REGION

SERIES I  
SPERMATOPHYTA



VOLUME 4

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DIRECTOR OF THE FOUNDATION 'FLORA MALESIANA'

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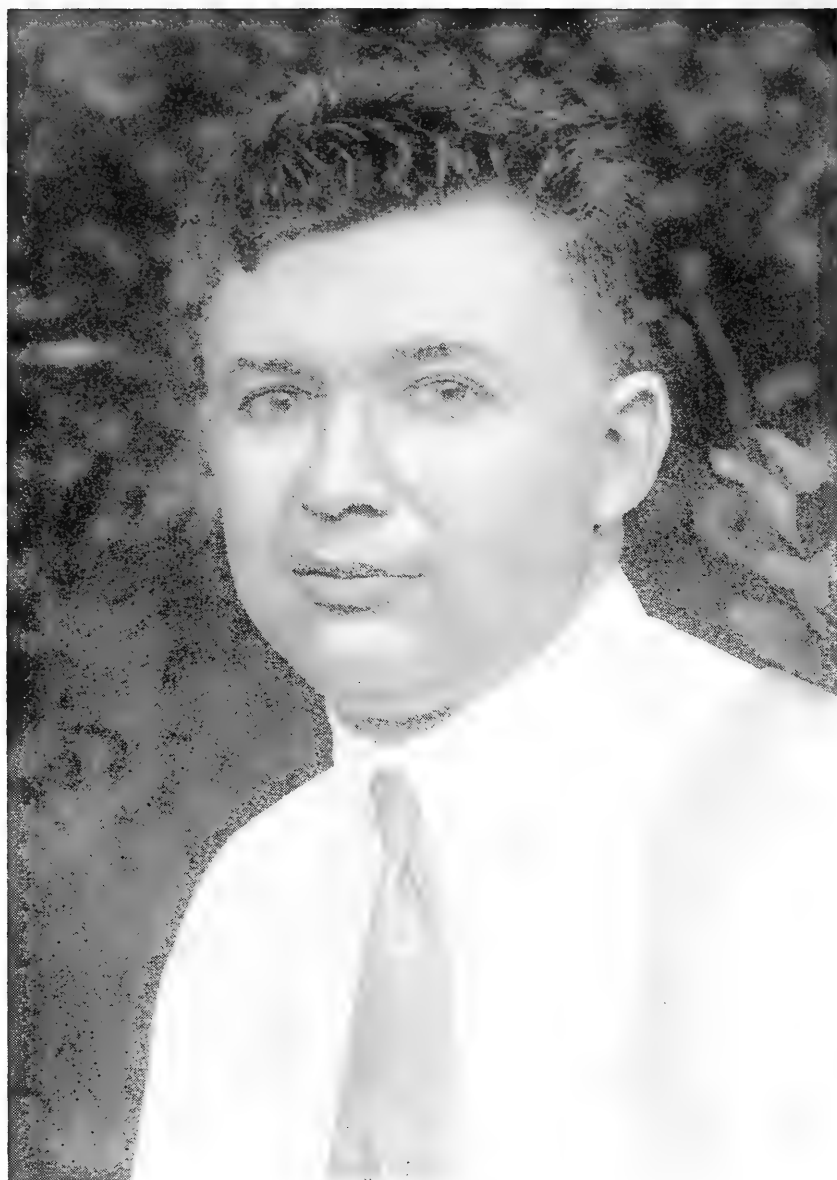
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*Dedicated to the memory  
of B. H. DANSER*

## DEDICATION

It is not without some pride and much satisfaction that the present volume, fourth planned in the series, second in sequence of publication, is brought to a successful end.

*Satisfaction* I feel through the fact that the scheme and aim of this work is not only understood by the scientific-botanical world, but has also been accepted in the administrative world: Notwithstanding the long term scope of the work, the High Government of the Republic of Indonesia, having realized the essential value of basic scientific work in the natural sciences for the welfare of the future generations of its young nation, has been instrumental in authorizing the Director of Kebun Raya Indonesia (Botanic Gardens of Indonesia, Bogor) to create a Flora Malesiana Foundation. Sponsored by the Indonesian Government, this Foundation knits together the work and interest of the Herbarium Bogoriense of Kebun Raya Indonesia and the Netherlands Rijksherbarium at Leyden, the direction of which have officially agreed to a long-range close co-operation.

The legal marriage in old age of these two institutes, together possessing more essential Malaysian collections than any other two institutes in the world, has, speaking metaphorically, not been wholly barren for their offspring is this child: Flora Malesiana. Both parents are tending it and giving to it all the time they can spare from their daily duties.

The *pride* I feel is due to the fact that so many experienced colleagues agreed to collaborate in the present work and that they belong to so many different institutes in so many countries as a team of workers in whose contributions nothing but goodwill is reflected in the international mirror of our *scientia amabilis*.

This goodwill is, in my opinion, to be attributed in no small degree to the set-up of the work: *concise, critical, original, and international*. Works of immense magnitude, like this Flora, are only of importance if they can reach a high-degree of precision. Such meticulous attendance to detail can only be attained by competent, that is, experienced workers who love their trade. And though a century ago one of the Makers of Botany, like a ROBERT BROWN, a HOOKER, or a BENTHAM, might have been able to accomplish such a work under very favourable conditions, as a single person with the help of a few eminent associates, in a single institute, it seems to me that this possibility is now beyond the capacity of any single person under present conditions. A work like this can only be accomplished within a reasonable period by close international co-operation.

Fortunately, it has appeared, during the few years that this Flora has been under way, that its appeal touched a string in international feelings and that the international scientific world shares a pride in its being a product of international science.

About 40 institutes all over the world—and all big herbaria containing an appreciable amount of Malaysian material are among these—have agreed to put their Malaysian collections at the disposal of the revisors and several among them deem it an honour to have staff members actually collaborating, taking a share in the undertaking. These privileges are so large that Flora Malesiana can never cherish any hope of rewarding them in any other way than by putting, in return, its services and resources at the disposal of the institutes, including the work itself, the literature which it creates, and by taking the most meticulous care in having the sheets of these institutions critically identified. In addition, every institution has a certain moral claim of participation in the realization of the work. May the world be at peace long enough to see it completed!

Flora Malesiana enjoys an equally great privilege from the confidence of a great number, over 50, of individual collaborators, who are similarly dispersed throughout the world. In the final instance, the standing of the work is dependent on the care and devotion they have spent and will spend on their work.

Phytography in the narrow sense is not a particularly difficult branch of the natural sciences but it is a very time-consuming one. Besides a *love* and *esteem* of the métier it requires a *memory* for forms, great *patience* and *care*, a never ending *self-criticism*, continuous concentrated *observation* of details, a great *tenacity* for mastering the facts both as regards specimens and literature, as well as a *balanced* and *unprejudiced character*. Sound judgement and creative output depend largely on experience and zeal and will develop automatically if the combination of the above-mentioned necessary qualities of character are present. It appears to me more and more that to be a trustworthy phytographer is largely a question of psychology and less so of education and circumstances. For the output, the amount of printed work, besides of course working facilities and time, balance of character is sometimes the decisive factor, and its absence

will lead to self-sterilization if the aim is set towards too many subjects at a time or towards an unreasonably high percentage of completeness. Striving after perfection may sometimes be a serious drawback to the quantity of production. Experience shows that it is impossible to reach 100% perfection: the curve evolving from the degree of completeness set out against the time necessary for the accomplishment shows a parabolic shape, and indicates that a reasonable ceiling is reached at possibly 90 to 95% after which it does not pay to proceed much further, by the law of diminishing returns.

My impression is that, if such a percentage can be maintained, Flora Malesiana will be at least as sound a basis for Malaysian botany, as the Flora of British India was at its time for the flora of the Indian tropics, and that it will represent a reasonable basis for a century to come.

As far as this volume and volume one are concerned, practical work with it up to now has shown that it contains no major defects, and the list of addenda and corrigenda is no greater than might reasonably be expected. I trust the future will show that this judgement will hold and no higher tribute can be expected by the collaborator than that his work is a useful tool for future generations.

Until now I have deliberately refrained from mentioning names of persons intimately connected officially or unofficially with the history of this Flora. So many persons have contributed that if I live long enough I may, some time, in the future, devote an essay to this interesting subject which forms the background of the genesis of Flora Malesiana.

But I will make an exception for one of them here, namely for my late friend Dr B. H. DANSER, to whose inspiring interest the set-up of this Flora is mainly due and to whose memory this volume is accordingly dedicated.

When in December 1927, I was appointed on the staff of the Botanic Gardens at Bogor, I had the particular privilege of joining a circle of senior, experienced colleagues who, all of them, were prepared to help a newcomer in their different ways.

They probably did not realize how much they contributed to the rounding off of my academic education and how much I borrowed from them during daily contacts when they, unconsciously, generously poured forth their knowledge. The embarrassment of a junior only acquainted with a small portion of the northern temperate hemisphere on changing his site to the rich tropical flora was easily overcome by the privilege of being initiated so rapidly and in such a pleasant way.

There was an immense advantage in working under these conditions in a centre like Kebun Raya Indonesia with its large, rich, living and preserved collections, its big library and other facilities, and its multifarious activities.

It was extremely fortunate for me that I had a room next to that of DANSER and it was with him that I had the most intimate contact for nearly two years.

BEN, as he was called by his intimate friends was a charming and gifted person. Privately he appeared devoid of social ambitions and averse from exercising authority. He pitied people who dealt in commonplaces. Speaking freely with his intimate friends he surprised us often with the most daring opinions and visions and did not care a damn about 'public opinion' with which he was disgusted: a free-thinker in format. Lively, intelligent, versatile, straightforward, unconventional, with a profound erudition, he had during argument—which he loved—a particularly kind and modest but still strongly convincing manner, flavoured by gesticulation. This often turned his talks, imperceptibly, into an interesting teaching to which I more listened than contributed. He always gave more than he received and what he gave was part of himself; he emptied himself, so to say, in a most unselfish way.

BEN was perfectly well aware of his educational gift and it is quite certain that he intentionally chose, in conformity with his style of life, a very artistic, clever book-plate, designed by Jordaan, showing a dancer, in ecstasy of the joy of life, lavishly scattering flowers and leaves. He confided to me that he took great pleasure in contact with his juniors and in teaching scientific botany, and that, as a matter of fact, his ideal was to be a professor of taxonomic botany. Quite unexpectedly, luck served him later and proved him to be the right man in the right place. Notwithstanding the fact that his versatile character ill fitted the rather stiff, uncommunicative North Netherlands mentality, he felt quite at ease at Groningen University and made himself a beloved professor, who gradually attracted various excellent students to taxonomy, a branch of botany until then untaught at Groningen and one which is, on the whole, apparently of not much appeal to students.

The outstanding quality to which he owed this success was his sincere interest in each student individually and the tact with which he treated him in accordance with his ambitions, his capacities, and his natural inclination towards scientific subjects. Everybody felt at ease with him through his simplicity, his willingness, his kindness, his wide interest and his vast knowledge.

Though he and I were of very different character, in various points even contrasted, I felt we fitted excellently together as we shared a high esteem for our *métier*, both practically and theoretically. His open character, treating everybody as his equal, his great energy and enthusiasm, the precise way in which he tried to make a cautious approach to essential things in systematic botany within his limits and powers of thinking, his despite of the copying of thoughts and statements without having them verified, his contempt for superficiality, his passion for essential facts, and his lack of prejudice, these all made him an ideal taxonomist, whose achievements in taxonomic botany would have been unique, had he lived long enough.

During these early years we discussed my vague plans for a general flora of the Netherlands Indies and he agreed that any delimitation of it by political frontiers would be a most disturbing factor from the technical-scientific point of view. He advised me to start in my free time, as a kind of exercise, with a small, concise local Flora for the 'Flore de Buitenzorg' series, initiated by TREUB at the end of last century. No doubt the background of this idea was to get me acquainted with techniques and floristics. As a matter of fact I followed his suggestions by making a private local herbarium and the idea proved fruitful for our later 'Flora for the schools in Indonesia' (1949). The discussions on the general Flora still occupied our mind when he left for Europe, at the end of 1929, and we continued to correspond on the subject until the war made further contact impossible. About 1936 I composed sample treatments of some small families which our friend VERDOORN had printed for the purpose we had in mind. In general this scheme was approved, but we differed on three rather important points in the scope and design of the work which—in principle—was approved and pushed forward by the later director of the Gardens, Prof. Dr L. G. M. BAAS BECKING. DANSER advocated a Flora limited to the Netherlands Indies, while my plant-geographical experience told me that this was a much too artificial boundary. He wanted the Flora with a very concise text along the lines of the Flora of British India, while I was more inclined to follow the more laborious method of the 'Contributions à l'étude de la Flore des Indes Néerlandaises'. Thirdly he suggested that editing and printing should be done in Europe. In the main points the facts have shown that he was right, though in actuality there has been a kind of intermediate result. This shows how difficult it is, even for insiders, to formulate a plan for a work of such a size, and that it should gradually mature through continuous thought and experience until its proposed shape attains a certain stage at which we are satisfied that we know what we want.

It shows also that one should be prepared to change or modify an idea and be entirely unprejudiced. DANSER was in this far more adaptable and his private letters show time after time his great patience with my stubbornness. As to the first point, I had, during the war, a particular advantage in being able to work out generic plant distribution in Malaysia and as a matter of fact my instinct, born of experience and field work, showed that any natural delimitation of Malaysia must embrace countries adjacent to Indonesia. I am convinced that DANSER, if he had known the facts, would have agreed on this point. The fact that he had mostly limited himself in his work at Bogor to herbarium research was partly responsible for his opinion. And this was caused again by his rather feeble strength which—though he liked field work—did not allow him to perform strenuous trips for longer periods and to learn to appreciate ecology and floristics. He had a great admiration for those who could do so.

As to the second point, I believe the outcome was that we made concessions on both sides, and again I am convinced that he would have appreciated the present satisfactory compromise. In the third point I was certainly wrong in my weighing of the balance. In the relatively isolated scientific position of one in the tropics—and this holds for other countries far remote from the centres of learning in the Northern hemisphere—most people inevitably overestimate what can be attained; due to the absence of comparable situations, the absence of enough constructive criticism, the idea that the man on the spot is the centre of the universe and is certain of the most sound judgement—which, it is true he often has in certain respects—, and to a certain self-sufficiency. It is no use denying these very human reactions and I am quite prepared to admit that I myself did not fail to react more or less along the lines indicated during my prolonged stay in Java. It was only after the war, that numerous personal contacts in various parts of the world showed me that there was no other way than that of the international co-operation DANSER had stood for, necessitating a separate branch in Europe.

The most important promise DANSER made to me was an agreement to act as joint editor of the Flora, and our plan was that he would co-ordinate the work in Europe while I would remain in Java. Unfortunately his untimely death changed all this, and I had to consider whether to carry on alone or to abandon the whole plan. I risked the first and had to readjust the execution of the work. I miss him most dearly, not only because he was an irreplaceable key person for

the work, but more especially because the loss of his kind devotion, his tolerant criticism, his valuable advice, and his trusted friendship leave a gap I cannot hope to fill.

BENEDICTUS HUBERTUS DANSER was born at Schiedam, Holland, May 24th, 1891, as the seventh child of a family of six elder sisters and a younger brother, the latter a gifted poet who died very young. At his secondary school he already felt an interest in biology and came into contact with two renowned Dutch amateur botanists, the late Dr W. H. WACHTER and our present revisor of the Gramineae, Dr P. JANSEN, who encouraged him in his botanical study. According to the biography they jointly wrote,<sup>1</sup> DANSER preferred zoology, especially insects, and more particularly butterflies, but he hated killing them and this induced him to take to botany. His love for music fitted well with his determined but gentle character; he possessed a big collection of gramophone records of classic music and in 1942 even took to playing the viola da gamba in a quartet. In his final examination at the secondary school he got the highest figure possible for Natural History. After that he became temporarily engaged as a teacher in a primary school. Unfortunately his feeble health soon revealed itself and he contracted tuberculosis which necessitated later (about 1920) a prolonged stay in a health-resort. This time he spent energetically in mastering the classic languages. He succeeded in 1913 in sitting for the State examination, necessary to enter the university under the then current regulations.

He entered Amsterdam University as an assistant of HUGO DE VRIES, later serving under THEO J. STOMPS. His main studies at Amsterdam were directed towards experimental taxonomy with the *Polygonaceae*, specially with adventive *Rumex* species and their hybridization. This subject had already interested him in his early days when he was a teacher in the primary school. His attention had been drawn to the *Polygonums* by a copy of a key prepared by his senior colleagues JANSEN and WACHTER. Apparently he tried to satisfy himself about the variability of species: at Kralingen he rented an allotment garden for cultivating *Polygonums*. As his neighbours were most curious about the new vegetable, but were soon expecting their gardens to be overrun with the results of DANSER's experiments, they threatened to bring an action against him, but soothing words and an open air lecture on seed dispersal warded off the danger and made it possible for him to continue the experiments for several years. The experimental side of taxonomy always remained one of his major interests. He shared LOTSY's views on the great significance of hybridization for speciation, without being prejudiced with reference to other means and ends of micro-evolution. In Java also he could not leave the subject alone and proceeded to cultivate and hybridize the 4 then ill-recognized species of *Stachytarpheta*. The fact that he worked both in the *Polygonaceae* and in *Stachytarpheta* with well-delimited species (commiscua) yielding only sterile hybrids, caused him to regard this as the normal case. Consequently he advised taxonomists, as early as 1924, to adjust specific delimitation as much as possible to that of commiscua. The concept *commiscuum* is—possibly—the most important one of the three he invented and defined, viz *comparium*, *commiscuum* and *convivium*, though the others are indeed quite useful. I am sure they will gradually find universal recognition in experimental taxonomy by their simplicity, and unambiguous definition.

At Groningen he continued further with the subject and various studies with Netherlands plants executed by his students were under way at the time of his death.

His career at Amsterdam was a busy one. He continued his systematic and experimental-taxonomic work on *Polygonaceae*, on which family he published a great number of papers, illustrated by drawings which he prepared himself. He became a custos and a honorary lecturer in taxonomy (1925), besides teaching natural history at a secondary school at Haarlem. However, he had no real pleasure in teaching either at a primary or a secondary school, as his interest lay mainly with grown up youths and adults. He took his degree as doctor of science at Amsterdam in 1921, on a thesis entitled 'Contribution à l'étude systématique du *Polygonum lapathifolium*' for which he received honours.

In the same year he was awarded the Netherlands Buitenzorg Fund and went to Bogor. After the Buitenzorg Fund term was over he accepted a temporary post in the Herbarium Bogoriense. Though urgently asked he did not want it to be permanent, partly on account of the dubious health of his wife whom he had met during his own cure, and who had, in contrast with himself, never wholly been cured. Moreover, he wanted to remain free in his choice where to settle.

DANSER enjoyed his work in the Botanic Gardens and worked very hard; many an afternoon one could find him in the Herbarium. He finished the *Polygonaceae* in one year, followed by the *Nepenthaceae* accomplished in the same time, and then he plunged into the large mistletoe family,

(1) Ned. Kruidk. Arch. 53 (1943) 129–136, bibl., portr.



encouraged by the then director of the Gardens Dr W. M. DOCTERS VAN LEEUWEN who worked on the flower biology of this group. This he felt was a worthy job for a taxonomist and his judgment led him to find a satisfactory distinction of genera, one lying midway between the rather opposed views of ENGLER, SPRAGUE, BLAKELY, etc. advocating a very large concept of *Loranthus* and the opinion of VAN TIEGHEM, who had split the genus into many dozens of micro-genera. I was a witness of the gradual progress of this work and found it a privilege to be asked sometimes to dissect the linear buds if BEN's nervous hands were not able to perform the operation. I strongly believe that he cleaned the Augean stables in this most interesting family as to the Old World representatives in a most satisfactory way. As he was quite convinced of the soundness of EICHLER's excellent work on the New World representatives, he thus contributed to pave the way for a world revision of this family.

As often as possible he made small, easy excursions to various parts of Java collecting *Loranthaceae* in the field. We often went together for this purpose. A small herbarium resulted from these excursions and is now preserved at the Botanical Laboratory of Groningen University.

In 1929 misfortune struck him, as his wife again fell a victim to her former illness; Javan health-resorts did not cure her and she was transported as swiftly as possibly to Switzerland where she died at Davos before he could reach her.

He afterwards visited some European herbaria to finish his revision of the *Loranthaceae* and accepted a post as assistant of Dr J. C. SCHOUTE, the professor of morphology at Groningen University, in 1931. A year later Prof. SCHOUTE retired and DANSER accepted the chair, for which he was so well suited, as already indicated above. In his own time he continued the study of the *Loranthaceae* and gradually started work also on other families, *Cornaceae*, *Santalaceae*, and finally the *Coniferae*. He also succeeded in attracting students to work on other Malaysian groups and several excellent theses were produced (BUWALDA on the *Umbelliferae*, BLOEMBERGEN on *Alangium*, WASSCHER on *Podocarpus*).

As in everything he did, he took great care in preparing his lectures; he varied and improved them continuously. His love of classic languages induced him to devote a special lecture to botanical Latin.

As mentioned before he once more became interested in Netherlands plants and in their experimental taxonomy and various studies were on their way when the war broke out. It was natural that he should join the redaction committee of the *Flora Neerlandica*, a new work planned by the Netherlands Botanical Society and perform part of the execution of the work at Groningen.

He remained very much interested in the theory of plant taxonomy, and he wrote several papers on this subject, excelling through their clear, methodological style.

His unexpected death by cerebral haemorrhage deprived Botany of one of the most brilliant Dutch taxonomists. *Flora Malesiana* owes to this most prominent and devoted collaborator more than to any other person.

He is survived by EMMY his (second) wife and 3 children in whose memory the picture of the beloved husband and father will remain vivid for ever.

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1926

De Polygonum-soorten der theetuinen op Java (Meded. van het Proefstation voor Thee, *no* 98: 19 pp.).

1927

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In memoriam Casper van Overeem (Bull. Jard. Bot. Btztg III, 9: 1–7).

In memoriam Dr C. van Overeem (Trop. Natuur 16: 57–58).

Indische Bekerplanten (Trop. Natuur 16: 197–205).

Polygonum-vegetaties in de tropen (Trop. Natuur 16: 28–35).

Polygonaceae (Nova Guinea 14<sup>2</sup>: 333–336).

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1928

The Nepenthaceae of the Netherlands Indies (Bull. Jard. Bot. Btztg III, 9: 249–438).

1929

Een paar algemeene Lorantheaceën (Trop. Natuur 18: 83–87).

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Ueber die Niederländisch-Indischen Stachytarpheta-Arten und ihre Bastarde, nebst Betrachtungen über die Begrenzung der Arten im Allgemeinen (Ann. Jard. Bot. Btztg 40: 1–44).

1931

The Lorantheaceae of the Netherlands Indies (Bull. Jard. Bot. Btztg III, 11: 233–519).

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1932

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1933

A new system for the genera of Lorantheaceae Lanthoideae, with a nomenclator for the Old World species of this subfamily (Verh. Kon. Akad. Wet. A'dam afd. Natuurk. (2e sectie), 29, *no* 6: 1–128).  
Thaumasianthes, eine neue Lanthaceengattung aus den Philippinen (Rec. Trav. Bot. Néerl. 30: 464–481).

1934

Miscellaneous notes on Lorantheaceae 1–6 (Rec. Trav. Bot. Néerl. 31: 223–236).

The Lorantheaceae of the Oxford University Expedition to Sarawak in 1932 (Rec. Trav. Bot. Néerl. 31: 237–247).

Miscellaneous notes on Lorantheaceae 7–8 (Rec. Trav. Bot. Néerl. 31: 751–760).

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1935

& J. C. MEKEL, Der Blütenstand und die Blüte von Korthalsella Dacrydii (Blumea 1: 312–319).

A revision of the Philippine Lorantheaceae (Philip. J. Sc. 58: 1–151).

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1936

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A new Papuan Didiscus (Brittonia 2: 135–136).

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1937

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1938

Miscellaneous notes on Loranthaceae 16–18 (Blumea 3: 34–59).

The Loranthaceae of French Indo-China and Siam (Bull. Jard. Bot. Btzg III, 16: 1–63).

1939

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1940

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1941

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The British-Indian species of *Viscum* revised and compared with those of South-Eastern Asia, Malaysia and Australia (Blumea 4: 261–319).

1942

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? 1954

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C. G. G. J. VAN STEENIS

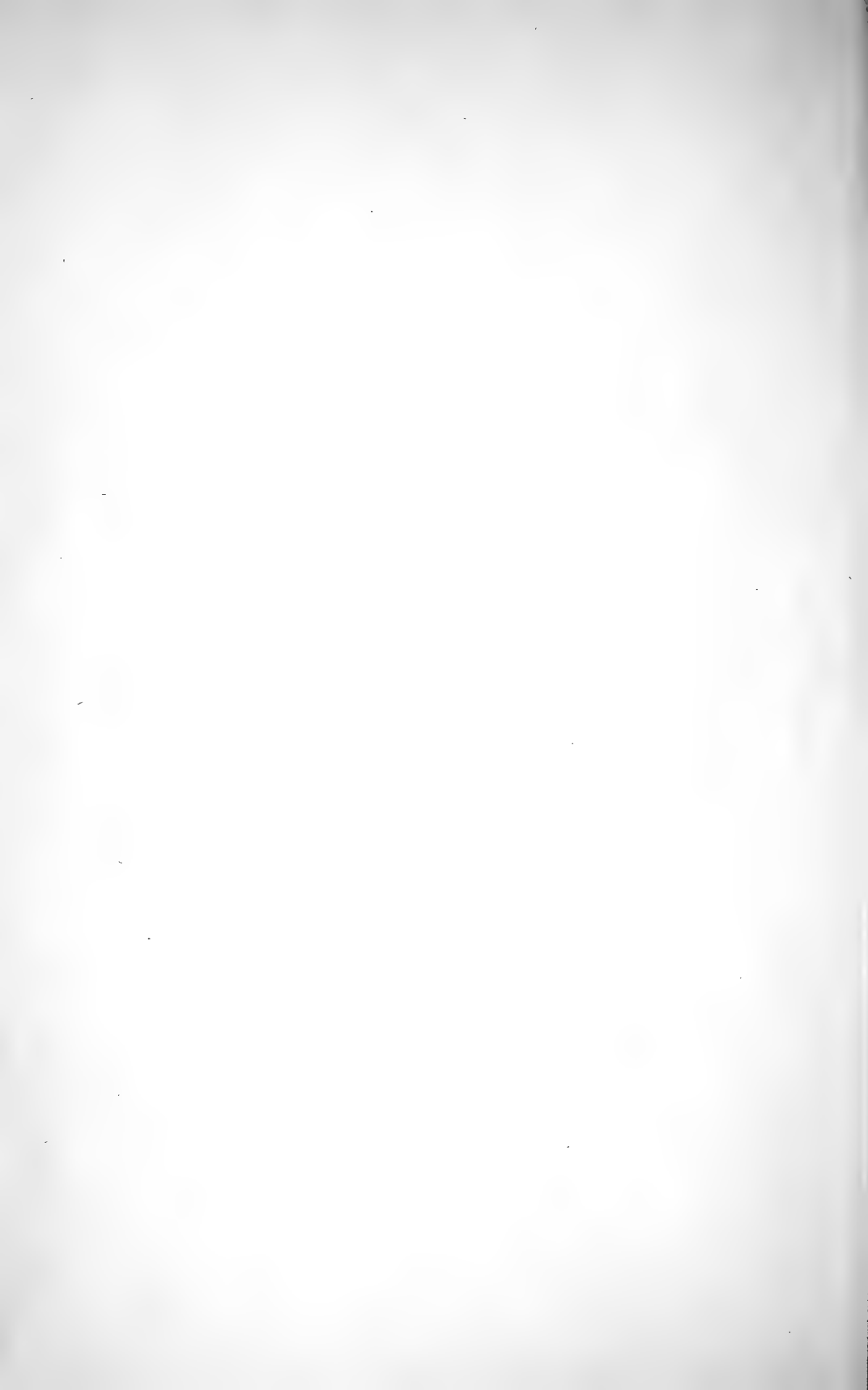
# ABBREVIATIONS AND SIGNS

- acc. = according  
 Ak. Bis. = Aklan Bisáya (Philip. language)  
 Alf. Cel. = Alfurese Celebes (language)  
 alt. = altitude  
 Anat. = Anatomy  
 Ap. = Apáyao (Philip. language)  
 app. = appendix, appendices  
 appr. = approximate  
 Apr. = April  
 Arch. = Archipelago  
 atl. = atlas  
*auct. div.* = *auctores diversi*; various authors  
*auct(t). mal.* = *auctores malayenses*; authors dealing with Malaysian flora  
*auct(t). plur.* = *auctores plures*; several authors  
 Aug. = August  
 Bag. = Bagóbo (Philip. language)  
 Bg = Buginese (language)  
 Bik. = Bikol (Philip. language)  
 Bil. = Bilá-an (Philip. language)  
 Bill. = Billiton  
 Bis. = Bisáya (Philip. language)  
 Bon. = Bontók (Philip. language)  
 Born. = Borneo  
 Bt = Bukit; mountain  
 Bug. = Buginese (language)  
 Buk. = Bukidnon (Philip. language)  
*c. & ca* = *circiter*; about  
 C. Bis. = Cebu Bisáya (Philip. language)  
*cf.* = *confer*; compare  
 Chab. = Chabacáno (Philip. language)  
 cm = centimetre  
*c.n.* see *comb. nov.*  
*comb. nov.* = *combinatio nova*; new combination  
*c.s.* = *cum suis*; with collaborators  
*cur.* = *curante*; edited by  
 D (after a vernacular name) = Dutch  
 Daj. = Dyak (language)  
 Dec. = December  
 D.E.I. = Dutch East Indies  
 diam. = diameter  
 Distr. (as an item) = Distribution  
 Distr. (with a geographical name) = District  
 Div. = Division  
*div.* = *diversus* (masc.); various  
*do* = *ditto* (Ital.); the same  
 Dum. = Dumágat (Philip. language)  
 dupl. = duplicate  
 E = east (after degrees: eastern longitude)  
 E (after a vernacular name) = English  
 Ecol. = Ecology  
 ed. = edited; edition; editor  
*e.g.* = *exempli gratia*; for example  
*elab.* = *elaboravit*; revised  
*em.* = *emendavit*; emended  
*em(erg.) ed.* = *emergency edition*  
 Engl. = English  
*etc., &c.* = *et cetera*; and (the) other things  
*ex auctt.* = *ex auctores*; according to authors  
*excl.* = *exclusus* (masc.); excluding, exclusive of  
*f.* (before a plant name) = *forma*; form  
*f.* (after a personal name) = *filius*; the son  
*f.* (in citations) = figure  
 fam. = family  
 Feb. = February  
*fide* = according to  
 fig. = figure  
*fl.* = *flore, floret (floruit)*; (with) flower, flowering  
 For. Serv. = Forest Service  
*fr.* = *fructu, frutescit*; (with) fruit, fruiting  
 Fr. (after a vernacular name) = French  
 G. = Gunung (Malay); mountain  
 Gad. = Gaddáng (Philip. language)  
*gen.* = *genus*; genus  
 Germ. = German  
*ib(id).* = *ibidem*; the same, in the same place  
 Ibn. = Ibanág (Philip. language)  
*ic.* = *icon, icones*; plate, plates  
*ic. inedit.* = *icon ineditum, icones inedita*; inedited plate(s)  
*id.* = *idem*; the same  
*i.e.* = *id est*; that is  
 If. = Ifugáo (Philip. language)  
 Ig. = Igorot (Philip. language)  
 Ilg. = Ilongót (Philip. language)  
 Ilk. = Ilóko (Philip. language)  
*in adnot.* = *in adnotatione*; in note, in annotation  
 incl. = including, inclusive(ly); *inclusus* (masc.)  
 indet. = indetermined  
 Indr. = Indragiri (in Central Sumatra)  
*inedit.* = *ineditus* (masc.); inedited  
*in herb.* = *in herbario*; in the herbarium  
*in litt.* = *in litteris*; communicated by letter  
*in sched.* = *in schedula*; on a herbarium sheet  
*in sicc.* = *in sicco*; in a dried state  
*in syn.* = *in synonymis*; in synonymy  
 Is. = Isinái (Philip. language)  
 Isl. = Island  
 Ism. = Isámál (Philip. language)  
 Iv. = Ivatán (Philip. language)  
 J(av). = Javanese (language)  
 Jan. = January  
 Jr = Junior  
 Klg. = Kalínga (Philip. language)  
 Kul. = Kuláman (Philip. language)  
 Kuy. = Kuyónon (Philip. language)  
 Lamp. = Lampong Districts (in S. Sumatra)  
 Lan. = Lánao (Philip. language)  
 lang. = language  
*l.c.* = *loco citato*; compare reference  
 livr. = livraison, part  
*ll.cc.* = *l.c.* (plur.)  
 m = metre  
 M = Malay (language)  
 Mag. = Magindanáo (Philip. language)  
 Mal. = Malay(an)  
 Mal. Pen. = Malay Peninsula  
 Mand. = Mandáya (Philip. language)  
 Mang. = Mangyán (Philip. language)  
 Mar. = March  
 Mbo = Manóbo (Philip. language)  
 Md = Madurese (language)  
 Minangk. = Minangkabau (a Sumatran language)  
 Mk = Makassar, Macassar (in SW. Celebes)  
 mm = millimetre  
 Mng. = Mangguárgan (Philip. language)  
 ms(c) = manuscript  
 Mt(s) = Mount(ains)

N = north (after degrees: northern latitude); or  
 New (e.g. in N. Guinea)  
 NE. = northeast  
 Neg. = Negrito (Philip. language)  
 N.E.I. = Netherlands East Indies  
 N.G. = New Guinea  
 N.I. = Netherlands Indies  
 no = number  
 nom. = *nomen*; name (only) = *nomen nudum*  
 nom. al. = *nomen aliorum*; name used by other  
 authors  
 nom. alt(ern). = *nomen alternativum*; alternative  
 name  
 nom. cons(erv). = *nomen conservandum*, *nomina  
 conservanda*; generic name(s) conserved by the  
 International Rules of Botanical Nomenclature  
 nom. fam. cons. = *nomen familiarum conservan-  
 dum*; conserved family name  
 nom. gen. cons. prop. = *nomen genericum conser-  
 vandum propositum*; generic name proposed for  
 conservation  
 nom. illegit. = *nomen illegitimum*; illegitimate  
 name  
 nom. legit. = *nomen legitimum*; legitimate name  
 nom. nov. = *nomen novum*; new name  
 nom. nud. = *nomen nudum*; name published with-  
 out description and without reference to pre-  
 vious publications.  
 nom. rej. = *nomen rejiciendum*; name rejected by  
 the International Rules of Botanical Nomen-  
 clature  
 non al. = *non aliorum*; not of other authors  
 nov. = *nova* (femin.); new (species, variety, etc.)  
 Nov. = November  
 n.s. = new series  
 n.sp. = *nova species*; new species  
 n. (sp.) prov. = *nomen (specificum) provisorium*;  
 provisional new (specific) name  
 n.v. = *non vidi*; not seen  
 NW. = northwest  
 Oct. = October  
 op. cit. = *opere citato*; in the work cited  
 p. = *pagina*; page  
 P. = Pulau, Pulu (in Malay); Island  
 Pal(emb). = Palembang  
 Pamp. = Pampangan (Philip. language)  
 Pang. = Pangasinan (Philip. language)  
 P. Bis. = Panay Bisaya (Philip. language)  
 P.I. = Philippine Islands  
 pl. = plate  
 pr. max. p. = *pro maxima parte*; for the greater  
 part  
 p(r).p. = *pro parte*; partly  
 prob. = *probabiliter*; probably  
 Prov. = Province  
 pt = part  
 Res. = Residency  
 resp. = respective(ly)  
 S = south  
 S(d) = Sundanese (language)  
 Sbl. = Sambali (Philip. language)  
 SE. = southeast  
 sec. = *secus*; according to  
 sect. = *sectio*; section  
 sens. ampl. (ampliss.) = *sensu amplo (amplissimo)*;

in a wider sense, in the widest sense  
 sens. lat. = *sensu lato*; in a wide sense  
 sens. str. (strictiss.) = *sensu stricto (strictissimo)*;  
 in the narrow sense, in the narrowest sense  
 Sept. = September  
 seq., seqq. = *sequens, sequentia*; the following  
 ser. = series  
 s.l. = see *sens. lat.*  
 S.-L.Bis. = Samar-Leyte Bisaya (Philip. language)  
 Sml. = Samal (Philip. language)  
 s.n. = *sine numero*; (specimen) without the collec-  
 tor's number  
 Sp. = Spanish (language)  
 sp(ec). = *species*; species  
 sphalm. = *sphalmate*; by error, erroneous  
 spp. = *species*; species (plural)  
 Sr = Senior  
 s.s. = see *sens. str.*  
 ssp. = *subspecies*; subspecies  
 s.str. = see *sens. str.*  
 stat. nov. = *status nova*; proposed in a new rank  
 Sub. = Subanon (Philip. language)  
 subgen. = *subgenus*; subgenus  
 subsect. = *subsectio*; subsection  
 subsp. = *subspecies*; subspecies  
 Sul. = Sulu (Philip. language)  
 Sum. E.C. = Sumatra East Coast  
 Sum. W.C. = Sumatra West Coast  
 Suppl. = Supplement; *supplementum*  
 SW. = southwest  
 syn. = *synonymum*; synonym  
 t., tab. = *tabula*; plate  
 Tag. = Tagalog (Philip. language)  
 Tagb. = Tagbanua (Philip. language)  
 Tagk. = Tagaká-ólo (Philip. language)  
 Tapan. = Tapanuli (in NW. Sumatra)  
 Tg = Tandjung (Malay); cape  
 Ting. = Tinggian (Philip. language)  
 Tir. = Tirurai (Philip. language)  
 transl. = translated  
 typ. excl. = *typo excluso*; type excluded  
 typ. incl. = *typo incluso*; type included  
 var. = *varietas*; variety  
 var. nov. = *varietas nova*; new variety  
 Vern. = Vernacular  
 vide = see  
 viz = *videlicet*; namely  
 vol. = volume  
 W = west  
 Yak. = Yakán (Philip. language)  
 ± = about  
 & = and  
 ♂ = male (flower, etc.)  
 ♀ = female (flower, etc.)  
 ♂ = bisexual (flower)  
 (♂) (♀) = dioecious with unisexual flowers  
 (♂ ♀) = monoecious with unisexual flowers  
 (♂ ♀) = polygamous  
 (♀ ♀) = polygamous  
 ∞ = very many  
 > = diminishing (in size, number, etc.)  
 < = accrescent (size, number, etc.)  
 × 2/5 = 2/5 of natural size  
 × montana = means that the epithet montana is  
 that of a hybrid





'S LANDS PLANTENTUIN , BOTANIC GARDENS  
BUITENZORG , JAVA , INDONESIA

# FLORA MALESIANA

*BEING*

*AN ILLUSTRATED SYSTEMATIC ACCOUNT OF THE MALAYSIAN FLORA,  
INCLUDING KEYS FOR DETERMINATION, DIAGNOSTIC DESCRIPTIONS,  
REFERENCES TO THE LITERATURE, SYNONYMY, AND DISTRIBUTION,  
AND NOTES ON THE ECOLOGY OF  
ITS WILD AND COMMONLY CULTIVATED PLANTS*

**PUBLISHED**

UNDER THE AUSPICES OF THE BOTANIC GARDENS, BUITENZORG,  
AND THE AUTHORITY OF THE CENTRAL GOVERNMENT OF INDONESIA,  
DEPARTMENT OF AGRICULTURE & FISHERIES

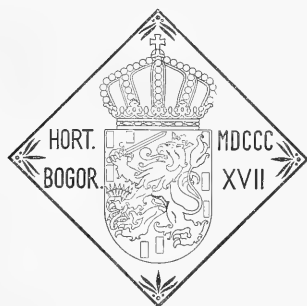
**PREPARED**

ON AN INTERNATIONAL CO-OPERATIVE BASIS UNDER THE SUPERVISION OF  
SEVERAL DIRECTORS OF BOTANIC GARDENS, KEEPERS OF HERBARIA  
AND VARIOUS PROMINENT BOTANISTS

**FOR THE PROMOTION OF**

BOTANICAL SCIENCE AND THE CULTURAL ADVANCEMENT OF  
THE PEOPLES OF SOUTH-EASTERN ASIA TO  
THE SOUTHWEST PACIFIC REGION

SERIES I  
*SPERMATOPHYTA*



VOLUME 4  
*PART I*

GENERAL EDITOR:

**DR C. G. G. J. VAN STEENIS**

SENIOR BOTANIST / BOTANIC GARDENS / BUITENZORG

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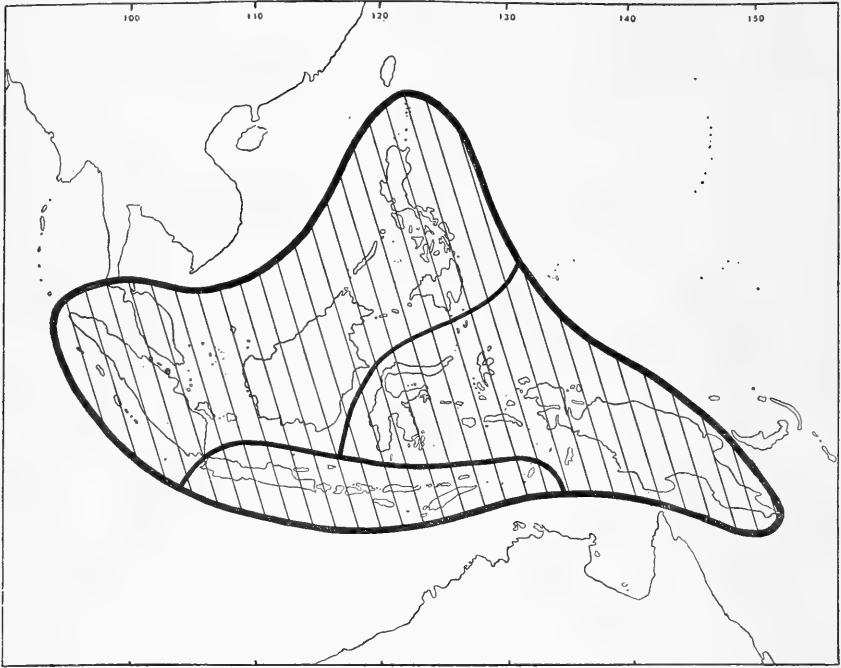
## NOTICE

Flora Malesiana is designed to represent a concise flora of the Malaysian region.

The present part is the first published. It contains the 1st instalment of vol. 4 of series I.

The following independent series are planned:

Series I. Spermatophyta ( <i>flowering plants</i> ) . . . . .	ca 15 volumes
Series II. Pteridophyta ( <i>ferns and fern allies</i> ) . . . . .	ca 3 volumes
Series III. Bryophyta ( <i>mosses and hepatics</i> ) . . . . .	ca 5 volumes
Series IV. Fungi & Lichenes ( <i>fungi and lichens</i> ) . . . . .	ca 3 volumes
Series V. Algae ( <i>algae</i> ) . . . . .	ca 3 volumes

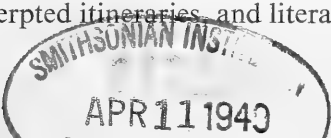


At the present moment preparations have been made necessary for the start of series I only. As soon as possible the other series will be commenced and directed by special general editors.—The area covered by Flora Malesiana is indicated on the accompanying map by the hatched area.

### PLAN FOR THE PUBLICATION OF SERIES I SPERMATOPHYTA

Volume 1. **Cyclopaedia of Malaysian botanical collectors and collections**, by Mrs M. J. VAN STEENIS-KRUSEMAN.

This is a cyclopaedia of Malaysian collections of Phanerogams and Pteridophytes. It contains over 3000 names of collectors, with short biographies, carefully excerpted itineraries, and literature pertaining to the collections.



Indispensable when localizing herbarium sheets of Malaysian plants and interpreting the scant notes on the labels of older collections. Contains also chapters on methods of collecting in the tropics, hints for travellers, notes on erroneously localized Malaysian collections, &c. — Ready for the press, probably available by the end of 1949. Appr. 600 printed pages. *Sample treatment at the end of this copy.*

**Volume 2. Malaysian plant life**, by Dr C. G. G. J. VAN STEENIS.

This is a second edition, much enlarged, of 'Maleische Vegetatieschetsen' (1935) by the same author. It deals with all vegetation types known in Malaysia, as far as described in literature and reports, or known to the author by personally acquired field knowledge, their status and interpretation, their relations, origin, distribution within Malaysia, and importance to mankind. Biological phenomena, both explained or yet unexplained will be briefly touched on. This book will be copiously illustrated. The MS. can be expected to be finished in 1950. Appr. 500 printed pages. *Sample treatment at the end of this copy.*

**Volume 3. Malaysian plant geography**, by Dr C. G. G. J. VAN STEENIS.

This volume consists of two parts. Part one deals with floristic plant geography and contains tables showing the distribution of the *ca* 2200 recognized indigenous genera of Malaysian phanerogams, compiled from literature and from the Herbarium. Further there are chapters on the history of phytogeographical theories and discussions, a provisional list of the genera with their synonymy, an attempt to divide the Archipelago into phytogeographical districts based on the hitherto known facts of generic distribution, and a discussion of the phytogeographical character of the islands or island groups separately. The MS. is far advanced but not yet ready for the press. *Sample treatment at the end of this copy.*

Part two will deal with the historical plant geography of the Malaysian region. This is only in the initial stage.

**Volume 4. Flora Malesiana proper.** Onwards of vol. 4 the revisions of the families will be printed in the sequence in which they are finished, irrespective of the alliance of the groups concerned. Vol. 4 will be opened by an introductory essay containing chapters on the importance of variability in Malaysian plants, special aberrations with which the Malaysian botanist is confronted in the field and with which he must be acquainted to judge their importance in the often scanty specimens available in the herbaria. A chapter is added on the history of Malaysian phyto-geography. An annotated list of existing revisions concludes the introduction.

## PROPOSED CONTENTS OF VOLUME 4

1. Preface.
2. Introduction.
3. General considerations.
4. History of descriptive Malaysian botany (by Dr H. C. D. DE WIT).
5. General plan of revisions and hints to collaborators.
6. Keys for identifying Malaysian plants.
7. Annotated list of former revisions.
8. Photographs of principal botanical contributors to Malaysian botany.
9. Systematic revisions of families of Phanerogams, incl. Bignoniaceae, Podostemonaceae, Droseraceae, Umbelliferae, Convolvulaceae, Dioscoreaceae, Plumbaginaceae, *etc. etc.*

# MANAGEMENT OF FLORA MALESIANA

Flora Malesiana will *not* be available for purposes of exchange; it is for sale only. *Co-operating and collaborating institutions* can obtain this flora at a reduced price. *For subscribers to a complete series* the price will be reduced. *For substantial collaborators* a special reduction will be fixed individually. *General volumes 1—3 will also be sold separately* to a limited extent.

## APPLICATIONS TO BE DIRECTED TO

N.V. Erven P. Noordhoff,  
P.O. Box 39,  
Groningen, Holland.

N.V. Noordhoff-Kolff,  
P.O. Box 103,  
Batavia-C., Java.

and in the Americas to:

The Chronica Botanica Co.,  
Book Department  
Waltham, 54, Massachusetts, U.S.A.

## SCIENTIFIC COMMUNICATIONS

concerning Flora Malesiana should be addressed to Dr C. G. G. J. van Steenis, c/o Rijksherbarium, Nonnensteeg 1, Leiden, Holland.

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MEMORIAE  
EORUM QUI SE FLORAE MALESIANAE PERSCRUTANDAE DEDERUNT  
ET NOBIS DUCES ET EXEMPLA FUERUNT  
GRATO ANIMO  
HOC OPUS DEDICANT  
AUCTORES

## PREFACE

There are only a few things left in common to the displaced and disjointed inhabitants of this Earth; they are the things spiritual.

Among those treasures of the mind natural science has come to the fore only in the last three centuries, as a lofty and impartial principle that tends to join people instead of disrupting them. Through war, famine and pestilence the undying fire of science has remained a steady beacon.

At the inception of a great work, which shall be the demonstration of the united effort of many workers, it seems meet to remember the function of Science, apart from its beneficial or detrimental applications. In these days the adjectives 'pure' and 'applied' have lost much of their meaning, and the Masters amongst us were the least concerned with this classification. Nevertheless, as long as sentiment, politics, greed and bigotry rule this world, a purely scientific endeavour may become a binding force between individual groups, and maybe, even between nations. At the beginning of this great project we therefore see already a dark shadow cast by this unfortunate era, but rather than to dwell on darker thought let us invoke the light that is cast by those that lived and worked in these regions before us, and let us consider this work as an apotheosis of the ideals formulated by Melchior Treub who, half a century ago, became the initiator of co-ordinated scientific effort in the tropics.

His ideals are still ours.

To the General Editor, Dr C. G. G. J. van Steenis, we all want to express our gratitude for his initiative, for his boundless energy and, especially, for his faith in this project.

To discuss the project of the Flora Malesiana from the technical side would be simply borrowing materials from the scientific collaborators.

Rather than to plagiarize it seems fit to leave these matters to the specialist. But as Director of the Scientific Institutes, called 's-Lands Plantentuin' I may express the satisfaction that our Government, almost a century after the foundation of our Herbarium, after 130 years of effort of these institutes, after the publication of innumerable, chiefly disjointed contributions, has decided to further a unified effort. Amongst the many accusations that our workers have suffered in the last years, some at least have some foundation. We have plowed too deep, we were too few, we did not seek enough contact. But the greatest blight of tropical science has been the lack of continuity. Now we may plow deep, but with many to help. Now we may proceed together and, let us hope, with continuity guaranteed.

The great 'Horn of Plenty', the cornucopia of our Malaysian Flora, which was opened by van Rheede and by Rumphius shall still flow for a long time. I wish great joy to those that shall have the privilege to examine its contents.



(L. G. M. BAAS BECKING)

Director of 's-Lands Plantentuin

1. *Systematice* plantas suas disponit verus Botanicus;  
Nec absque ordine easdem enumerat.
2. *Fructificationis* principium in theoretica dispositione agnoscit;  
Nec dispositionem secundum Herbam immutat.
3. *Genera* naturalia assumit;  
Nec Erronea ob speciei notam aberrantem conficit.
4. *Species* distinctas tradit;  
Nec e Varietatibus falsas fingit.
5. *Varietates* ad species reducit;  
Nec eas, pari passu, cum speciebus obambulare sinit.
6. *Synonyma* praestantissima indagat et seligit;  
Nec acquiescit in quacunque obvia nomenclatura.
7. *Differentias* characteristicas inquirat;  
Nec inania nomina specifica praeponit veris.
8. *Plantas* vagas ad Genera amandare studet;  
Nec rariores obvias fugitivis oculis adspicit.
9. *Descriptiones* complectentes differentias essentielles, compendiose sistit;  
Nec naturalissimam structuram oratorio sermone ebuccinat.
10. *Minimas* partes attente scrutatur;  
Nec ea, quae maxime illustrant, flocci facit.
11. *Observationibus* ubique plantas illustrat;  
Nec in vago nomine acquiescit.
12. *Oculis* propriis quae singularia sunt observat;  
Nec sua solum, ex Auctoribus, compilat.

LINNAEUS, *Philosophia botanica*

# INTRODUCTION

After the appearance of RUMPHIUS's *Herbarium Amboinense*, the result of lifelong research into the botanical treasures of the Malaysian Archipelago, the first comprehensive work on the flora of these islands was begun by C. L. BLUME, the second Director of the Botanic Gardens at Buitenzorg. His *Bijdragen tot de Flora van Nederlandsch Indië* (Contributions to the Flora of the Netherlands Indies) consisted of numerous brief botanical diagnoses mostly, however, of Javan species. Shortly after followed his *Flora Javae* and later *Rumphia*. None of these books represent a 'flora'; neither completeness was aimed at nor keys were given.

The first design for a flora of the whole of Malaysia seems to have been drafted by the Swiss botanists H. ZOLLINGER and his teacher, A. MORITZ.<sup>1</sup> I have not succeeded in tracing any further results of their plans.

Since the publication<sup>2</sup> of the *Flora van Nederlandsch Indië* or *Flora Indiae Batavae* by F. A. W. MIQUEL (5 vols, 1854-'60)—which was no 'flora' in the present meaning of the word, keys being almost absent—no work has been conceived with the object of covering the Malaysian region. MIQUEL's work<sup>3</sup> may be considered as a more or less critical compilation of descriptions, mostly copied or extracted.<sup>4</sup>

MIQUEL must have realized that by his *Flora* the proper work was only started. This may be concluded from the series of revisions which MIQUEL, together with some specialists, published in 4 volumes *Annales muséi botanici lugduno batavi* (1863-'69),<sup>5</sup> *Choix des plantes rares ou nouvelles* (1863), to which was added his posthumous *Illustrations de la Flore de l'Archipel Indien* (1870-'71) by his successor at Leyden University, W. F. R. SURINGAR.

Unfortunately, MIQUEL had few pupils<sup>6</sup> which caused a serious shortage of well-trained systematists during half a century of botanical endeavour in the East Indies. The only Dutch scientists studying the Malaysian flora were:

P. DE BOER, who wrote his doctor's thesis on the subject *De Coniferis archipelagi indici* (1866), and later became a professor of Pharmacology at Groningen University, and

R. H. C. C. SCHEFFER, an extremely able bota-

nist whose thesis was entitled *De Myrsinaceis archipelagi indici* (1867).

SCHEFFER was subsequently appointed as the (fourth) Director of the Botanic Gardens, Buitenzorg, and ardently promoted the study of the Malaysian Flora, notwithstanding his feeble health. In his term of office he published several important papers, most on *Annonaceae*<sup>7</sup> and *Palmae*.<sup>8</sup>

DE BOER had one pupil in systematic botany, TH. VALETON, who obtained his doctor's degree on a monographic study of the *Olacineae*.<sup>9</sup> He eventually was employed as a bacteriologist in the Sugar Experiment Station in Java but, soon after, joined the staff of the Botanic Gardens, Buitenzorg (1892).

After the appointment of Dr M. TREUB as the fifth Director of the Gardens in 1880, interest in the promotion of knowledge of the Malaysian flora revived, but TREUB was badly handicapped by the absence of trained Dutch systematists. TREUB—a contemporary of HOOKER, EICHLER, BENTHAM, and HARVEY & SONDER, the editors of respectively the *Flora of British India*, the *Flora Brasiliensis*, the *Flora Australiensis*, and the *Flora of tropical Africa*—was well aware that systematic botany in the Netherlands Empire was on the verge of falling behind that in other tropical countries. He judged the advancement of systematics of pre-eminent importance.

He engaged W. BURCK, a pupil of SURINGAR's at Leyden, later a teacher of botany at Buitenzorg, as a subdirector of the Gardens (1883) and charged him with critical research into *Sapotaceae* (getahpertja family),<sup>10</sup> *Mucuna*,<sup>11</sup> the *Erythroxylaceae* (cocafamily),<sup>12</sup> and *Dipterocarpaceae*,<sup>13</sup> mostly families of economic importance.

TREUB, who tried continuously to raise a worldwide interest in the Gardens and its botanical institutes, considered the compilation of a new Malaysian Flora to be premature. Collections were inadequate and of the vegetation of the surrounding regions little was known.

He advanced, therefore, the idea of composing a local flora of the surroundings of Buitenzorg, covering the region from the mangrove of Tandjong Priok to the summit of Mt Gedeh at 3000 m. All altitudinal zones would thus be represented.

This *Flore de Buitenzorg* would serve as a guide to botanically interested visitors of the Gardens and be equally acceptable to residents of Java. Dr J. G. BOERLAGE, then conservator of Leyden Herbarium, during a visit to Buitenzorg as a stipendiate of the Dutch Buitenzorg Fund, had already made collections for the new flora (1889) and published an article on the grasses.<sup>14</sup>

(1) Ann. Jard. Bot. Btzg 2 (1885) 1-31.

(8) *Ibid.* vol. 1 (1876) 103-164; O. BECCARI, Reliq. SCHEFF. *ibid.* 2 (1885) 77-171.

(9) Critisch overzicht der *Olacineae* (1886).

(10) Ann. Jard. Bot. Btzg 5 (1886) 1-85.

(11) *Ibid.* 11 (1893) 183-190.

(12) *Ibid.* 11 (1893) 190-194.

(13) *Ibid.* 6 (1887) 145-249.

(14) Ann. Jard. Bot. Btzg 8 (1890) 47-78.

(1) ZOLLINGER, Observationes phytographicae etc. Natur- & Geneesk. Arch. 1 (1845) 375; cf. also J. K. HASKARL, Flora 30 (1847) 299.

(2) Made possible by a grant of the Ministry for the Colonies.

(3) Dates of publication of the several parts in Bull. Jard. Bot. Btzg III, 13 (1934) 284.

(4) Compare ZOLLINGER, Natuurk. Tijdschr. Ned. Ind. 13 (1857) 292-322; *id.* (in German), Vierteljahrschr. Naturf. Ges. Zürich 2 (1857) 318-349.

(5) Dates of publication of the several parts cf. NAKAI, Journ. Arn. Arbor. 6 (1925) 211-213.

(6) Cf. the article in honour of Dr A. A. PULLE, who resumed MIQUEL's work at Utrecht University, Bull. Jard. Bot. Btzg III, 16 (1939) 103-105.

TREUB, however, found it difficult to rally workers to this local flora and so most of it was assigned to foreign visitors who sometimes were temporarily employed at the Gardens. Six volumes appeared viz the *Myxomycetes* by O. PENZIG (1898), *Ferns and Fern Allies* by M. RACIBORSKI (1898), *Hepatics* by V. SCHIFFNER (1900), *Algae* by E. DE WILDEMAN (1900), and *Mosses* by M. FLEISCHER (1900-'22, 4 vols). The 6th and only volume on Phanerogams was written by J. J. SMITH (*Orchidaceae* 1905, atlas 1908-'14).

None of the volumes of the *Flore de Buitenzorg* bears the character of a local flora; the majority deal with the whole of Java. FLEISCHER'S *Musci* even expanded to a standard work on the world's mosses.

Of the flowering plants apart from the *Orchidaceae*, much material was collected by BURCK and H. HALLIER who planned to elaborate a 7th volume of the *Flore de Buitenzorg*. A list of the species to be included is kept at Buitenzorg, but nothing ever appeared in print.

During this period important revisions of families were published abroad by O. BECCARI in his 3-volume *Malesia*. Several monographs appeared in the 4<sup>0</sup> tomes of the *Annals of the Royal Botanic Gardens, Calcutta*, on the genus *Ficus*, the oaks and chestnuts, the bamboos, etc.

Local floras of other parts of Malaysia were the 3rd edition of BLANCO'S *Flora de Filipinas* (1877-'83)<sup>1</sup> by NAVES & F.-VILLAR, SCHUMANN & HOLLRUNG'S *Flora von Kaiser Wilhelmsland* (1889), and SCHUMANN & LAUTERBACH'S *Flora der Deutschen Schutzgebiete in der Südsee* (1901) with the *Nachträge* (1905). These eastern floras resembled enumerations and were mainly indices of materials collected on expeditions.

In 1890 BOERLAGE previously having published two critical studies of Malaysian plants, viz the genus *Achyranthes*<sup>2</sup> and the genera of *Araliaceae*,<sup>3</sup> started a work of quite another nature in the compilation *Handleiding tot de kennis der flora van Nederlandsch Indië*.<sup>4</sup> This comprised a description of the families and genera of Malaysian phanerogams. The species were—especially in the last parts—only briefly enumerated. He added to a few families keys to the genera. The generic descriptions were mostly critically copied from BENTHAM & HOOKER'S *Genera Plantarum*, and occasionally emended. Phytographically BOERLAGE'S *Handleiding* brought hardly anything new, but now a comprehensive review in the Dutch language of families and genera came within reach of interested persons in the colonies. However, as will be demonstrated later, this interest was and is still more directed towards *species* than *genera*.

(1) On the dates of publication see MERRILL, Philip. J. Sc. 12 (1917) Bot. 113-117.

(2) Ned. Kruidk. Archief II, 5 (1889) 420-430.

(3) Ann. Jard. Bot. Btzg 6 (1887) 97.

(4) In total 5 parts appeared, the last posthumously (1890-1903, 3 vols). The publication was made possible by a grant of the Ministry for the Colonies.

BOERLAGE'S work was more intended as a prelude to a general flora than as a final work.

He accepted (1896) the post of subdirector of the Botanic Gardens and Head of its first Division (Herbarium and Botanical Museum), as a successor to BURCK and began a monograph of the *Annonaceae*<sup>5</sup>. Unfortunately he soon (1900) fell a victim to a tropical disease while on a tour in the Moluccas attempting to re-collect the plants mentioned by RUMPHIUS in his *Herbarium Amboinense*.

Another flora was started, at TREUB'S instigation, of trees growing in the island of Java. This was to be based mainly on the collections made by Forest officer S. H. KOORDERS who gathered in the field notes on each species (occurrence, value, uses, etc.). Scientific descriptions and keys were by TH. VALETON. This work is *Bijdragen tot de kennis der Boomsoorten van Java (Additamenta ad cognitionem Florae Javanicae, pars I, Arbores)*. Thirteen volumes compose this standard work, the 12th volume is by J. J. SMITH, the concluding 13th by SMITH and VALETON. The work was begun in 1894, and finished in 1913. Later illustrations were edited by KOORDERS in his unfinished *Atlas der Baumarten von Java* (4 vols, 1913-'18). The *Bijdragen* is an excellent work with critical descriptions and notes, and still very useful though, of course, now antiquated. The descriptions of the species and genera are both in Dutch and Latin.

During TREUB'S directorate many collections, specially of the Outer Provinces,<sup>6</sup> were brought together. HALLIER made an important one in West Borneo, KOORDERS in Java and North Celebes, the SARASINS collected in Celebes, FORBES and KOORDERS in Sumatra, FORBES in Timor, while WARBURG'S, SCHLECHTER'S, and BECCARI'S great collections equalled those of TEYSMANN'S and extended over the whole archipelago. These collections were partly inaccessible though together they could have served to a large measure as a reliable basis for a *Flora Malesiana*.

Lack of trained taxonomists induced TREUB to engage J. J. SMITH, formerly an assistant curator of the Gardens, for taxonomic work. His revisions of Javan *Euphorbiaceae*, *Ulmaceae*, *Urticaceae*, and *Orchidaceae* proved his ability, and SMITH spent his life in describing Malaysian *Orchids*, *Ericaceae*, and *Epacridaceae*. Unfortunately, he did hardly any monographical work.

For the same reasons TREUB selected C. A. BACKER, a teacher in a primary school at Batavia who possessed already a thorough and critical knowledge of the local flora. BACKER intended to fill the still existing *lacunae* in the phanerogamic part of the *Flore de Buitenzorg*, which resulted in the publication of one volume of a *Flora van Batavia* (1907). This was followed by a preliminary *schoolflora*<sup>7</sup> and later by the *Schoolflora* (1911).

(5) Icon. Bogor. 1 (1899) 79-208, t. 26-75.

(6) That was: Netherlands Indian territory outside the islands of Java and Madoera.

(7) *Voorlooper eener Schoolflora van Java (Preliminary Schoolflora of Java)*. Batavia (1908).



The latter excellent work contained only  $\pm 25\%$  of the Javan flora (*Choripetalae*). He later devoted all his time to the Javan flora, wrote (together with VAN SLOOTEN) a weed flora of tea plantations (1924), 3 instalments of a *Handboek voor de Flora van Java* (1924-'28), a weed flora of sugar plantations (1928-'34; vol. II (atlas) not yet completed), and is now engaged in completing the Flora of Java.<sup>1</sup>

An ill-advised enterprise was a flora of Java by S. H. KOORDERS who, when charged by the N.I. Government to write a flora of the Javan mountains, abandoned this concept and hurriedly compiled an *Exkursionsflora von Java* (Jena, 1911-'12, 3 vols) which did more harm than good and is scarcely of any value to a student of the Javan flora.

The flora of the Malay Peninsula was originally included in the Flora of British India, but as the account remained very incomplete KING & GAMBLE, and RIDLEY, started to work on it, publishing a true model of a critical local flora.<sup>2</sup> This was later followed by RIDLEY's decidedly uncritical *Flora of the Malay Peninsula* (5 vols, 1922-'25).

On the Flora of Borneo a most helpful *Bibliographic enumeration of Bornean plants* was prepared by Dr E. D. MERRILL.<sup>3</sup>

In the Philippines MERRILL, after 1902, energetically undertook the research of the Philippine flora, this first resulting in an excellent local *Flora of Manila* (1912), in a large number of papers dealing with several aspects of the Philippine flora, and crowned by his *Enumeration of Philippine flowering plants* (1923-'26).

The results of frequent expeditions into the Dutch and German territories of New Guinea were published by Dr A. A. PULLE and others in the serial *Nova Guinea* (vols, 8, 12, 14, and 18), and by C. LAUTERBACH and others,<sup>4</sup> and in recent years those of Dutch and British parts by MERRILL and other collaborators.<sup>5</sup>

The undesirability of compiling, at this stage, local floras in Malaysia. The studies of the materials of various separate regions persuaded some leading Dutch botanists in the first quarter of our century—for some reasons they doubted the feasibility of a Malaysian flora as a whole—to propose several local floras e.g. one of Java, of Borneo, Sumatra, Celebes, etc. This caused the appointment of HALLIER at Leyden to write a Flora of Borneo resulting in a small preliminary paper.<sup>6</sup>

It is clear that this was a wrong policy, born from

either ignorance of the taxonomic position and the technique of writing revisions, or from the wish for dodging obstacles; the difficulties should be faced directly. Only temporary profit may be gained from making local floras, and both valuable time and money are wasted by the enormous duplication which is unavoidable when the goal of a flora of a plant-geographical unit is to be reached along this tortuous road.

The natural sequence is to start with the large flora, eventually followed later by local floras, a procedure followed in the great floras of South America, tropical Africa, India, and Australia. The unnatural sequence of starting with the local flora has led, both in North America and Europe, to a most regrettable state of affairs.

The absence of a general flora is also one of the causes that the flora of Java which BACKER has studied close on forty years is only now more or less to be completed. It contains several families which cannot be critically treated (*Lauraceae*, *Araceae*, *Zingiberaceae*, etc.) lacking revisions of these families in the whole Malaysian region.

**General Flora.** A general flora was and is needed and prospects at the end of the first World War seemed favourable. The Forest Research Institute and the Museum for Economic Botany<sup>7</sup> at Buitenzorg requested much service and urged the Herbarium of the Botanic Gardens to produce speedy results. This induced the Government to add to the staff of the Herbarium R. C. BAKHUIZEN VAN DEN BRINK (1917)—he was originally a plantation assistant—Dr D. F. VAN SLOOTEN and Dr H. J. LAM, the first pupils of PULLE at Utrecht (1919). In 1921 Dr H. C. CAMMERLOHER, a German biologist, was appointed, and a professional collector engaged, H. A. B. BÜNNEMEIJER.

At the same time a scheme was made for critical revisions. These were to be published in the *Bulletin du Jardin Botanique*, Buitenzorg<sup>8</sup> under the heading: *Contributions à l'étude de la Flore des Indes Néerlandaises*. Economically important families had priority. The method of treatment stood below that of KING & GAMBLE's *Materials* in so far that descriptions were only admitted if species were new or critical. This was believed to save time. On the other hand extensive lists of herbarium numbers had to be compiled. If the latter had been left out and instead a concise characteristic of the occurrence of the species given, besides a good diagnostic description of each species, the *Contributions* would have made a most satisfactory foundation. Though the later *Contributions* are far more complete than the earlier, the manner of treatment and publication is so laborious and slow that at this rate the Flora Malesiana will never be completed. Till the present 34 *Contributions* have appeared, comprising 2000 species.

Due to the post-war economic depression of 1921-'22 the Staff of the Buitenzorg Herbarium

(7) Head of this Museum was the late K. HEYNE, author of the standard work on useful plants of Indonesia (1927).

(8) *Bull. Jard. Bot. Btzg III*, 5 (1923) 294 seq.

(1) Seven parts of a mimeographed emergency edition were issued up till now through the care of the Rijksherbarium, Leiden (1940-'48), 9 vols.

(2) The contributions of the former appeared under the title *Materials towards a Flora of the Malay Peninsula* in various numbers of the Journ. Asiat. Soc. Bengal, vol. 58 onwards (18891-915).

(3) Journ. Str. Br. Roy. Asiat. Soc. Special number (1921).

(4) Under the title *Beiträge zur Flora Papuasiens* in many volumes of the Botanische Jahrbücher (1912 onwards).

(5) Journ. Arn. Arb. 9 (1928) et seq.

(6) *Beih. Bot. Centralbl.* 2. Abt. 34 (1916) 19-53.

were reduced, and though towards 1930 there were a few constructive moments, a protracted slump set in after that year and the Staff at Buitenzorg were reduced to the barest minimum. Shortly before the Pacific War the Staff again increased but the circumstances limited advancement of the Flora to planning.

I have always felt it as a shortcoming, and not in accordance with the standing of the great work at hand, that the contributions appeared in a periodical as scattered articles and not as a separate publication.

The work was undertaken on full official authority but being printed in an irregularly interrupted series of articles in many volumes of a technical journal, it was practically inaccessible to a wider non-professional public. A standard work of this scope and weight meant to be used by future generations and worthy of the wonders of nature in this great land ought to have commanded considerable interest in and beyond the tropics, specially so in neighbouring countries. It would not have made a difference in expenditure to issue this work as a separate publication thus materially augmenting its practical importance, its intrinsic value remaining, of course, the same.

This seemingly trivial technical-editorial point had very undesirable consequences. If the Government had once for all decided to order a standard work on the Malaysian flora to be written with all possible expediency and to be used many years afterwards, the halting and haphazard progress in the decade preceding the Pacific War would never have occurred.

It is a gratifying thought that the turbulent times of the present could not prevent the Government now to put the Flora Malesiana in an advantageous and satisfactory position both as regards effective publication, and national and international collaboration of systematists. Co-operation with foreign colleagues, whose help is invited and whose help is needed in order to finish the work within a reasonable time, will now, presumably, more easily be obtained. Evidently, it is far more attractive and stimulating to be entrusted with an individual part of a standard work than with writing an article in a journal.

**Prospect and scope of the Flora Malesiana.** A general flora of Malaysia must result from a careful study of all previous publications, blending them into a harmonious whole, and so founding Malaysian botany on a secure base of historical fact, observation, and accurate description. This is, however, the labour of a lifetime, and although I may be privileged in witnessing the laying of the foundations and the issue of a number of volumes, I cannot hope to bring it to a conclusion; progress, moreover, will depend entirely upon circumstances at present beyond control. I have no doubt that when I will be called to abandon this endeavour the historical necessity for the completion of this work will compel someone to continue this task and, eventually, to finish it.

It would, however, be wrong were I to convey the impression that this arduous undertaking had

entirely originated with myself: on the contrary during many years the conviction has grown among plant taxonomists that the ample collections accumulating in this country warranted the preparation and publication of a Flora Malesiana. The collections are undeniably extensive having been gathered over a wide extent of country.<sup>1</sup>

As I am anxious to render each portion of the work in itself as complete as possible, and desirous of enlisting those of our fellow-botanists as may be willing to take care of those families or groups they are most familiar with, the Flora Malesiana, when terminated will probably consist of a series of local-monographs. For these reasons it seems inadvisable and most inconvenient to arrange the families in the mode of sequence usually adopted in systematic works.

I consider it important that the Flora Malesiana should embrace as wide an area as possible, being firmly convinced that no species can be properly defined, until it has been examined in all variations induced by the differences in climate, locality, and soil, which an extensive area affords. Also, the flora of an area cannot be worked out thoroughly without a knowledge of the botany of the surrounding countries (these have many plants in common), and so the greater the area encompassed, the better it will illustrate habits, forms, and variations of the species comprised within it. For this reason we have extended the limits of our Flora from Sumatra to New Guinea and from Luzon to Christmas Island, Timor and New Guinea.

**The use of the Flora Malesiana.** In the preceding pages I have mentioned several times the public and the government. Both have a right to a clear understanding of the use of a flora of the scope and character of that now contemplated.

Although it is difficult to explain theoretically the 'use', *i.e.* the material benefit of purely scientific standard works, many anecdotes and instances concerning scientists entirely possessed by their inventions, instruments, and desire for research, told in biographies and popular literature, exemplify the eminently practical results based on seemingly impractical and abstract study.

The same can be said about this Flora. Botany is not a cherished source of pleasure and interest to naturalists only; and I have but vague ideas of

(1) Collections have increased enormously. From 1917 on, the Forest Research Station at Buitenzorg accumulated materials of arboreal plants from the islands outside Java (more than 30,000 numbers): The Museum for Economic Botany furnished by its own collectors another 6000 numbers of those islands. The collectors of the Buitenzorg Herbarium in the past 30 years added to the collections more than 125,000 numbers. A similar increase of Malaysian collections in these last decades is due to the activities at Manila and Singapore; besides, private collectors substantially augmented the collections of New Guinea. A conservative estimate of the collections at Buitenzorg alone runs to about 400,000 numbers of Malaysian plants.

possible advantage and ultimate gain for the community and practice by means of this registration of the Malaysian flora.

I could refer, of course, to the fact that all other civilized nations have already made considerable progress in the task of making common knowledge of their vegetable resources.

Actually the disentangling of confused species, the description of new or the rehabilitation of obsolete genera, the dissection of dried flowers and, in general, the establishment of law and order in 'the hay loft', and the publication of the results have less appeal to the lay public than the segregation of a new promising variety of rice or sugarcane, or devising a method to suppress a pest of coffee or of coconut plantations.

The Flora of Malaysia contains besides highly interesting and even unique plant forms, instructive vegetation types, and peculiar ecological and phytogeographical problems, numerous important industrial plants and economic products which, in their manifold kinds, add to human comfort and social prosperity, while, in their ranks, many treasures still await discovery, the latest accessions being pectin and mannan producing plants. Their value has come as a surprise both to taxonomists and economists.

Nearly a century ago, one of the foremost of British botanists, Sir JOSEPH DALTON HOOKER<sup>1</sup> wrote an introductory essay to the Flora of British India, one of the most instructive general essays ever written on tropical botany. This nearly one century old exposition of facts and thought meets the present state of knowledge of the Malaysian flora admirably. Its excellence induced me to copy the following from it:—

"With regard to economic botany, it is obviously impossible to do more than briefly enumerate, under their respective species, the various products which have been used in the arts: for detailed accounts of their value, we must refer our readers to the many excellent works on those subjects, which have been published by Indian botanists."

"Our work is intended to facilitate the progress of economists, by supplying their great desideratum, a critical description of the plants which yield the products they seek. We have had a considerable experience both in medical and economic botany and we announce boldly our conviction, that, so far as India is concerned, these departments are at a standstill, for want of an accurate scientific guide to the flora of that country. Hundreds of valuable products are quite unknown to science, while of most of the others the plants are known only to the professed botanists. The mass must indeed always remain so: just as the refinements of the laboratory and the calculations of the mathematician must ever be mysteries to the majority of manufacturers and navigators, whose operations are based on the sciences in question. It is a mistake to suppose that it can be otherwise; or that those who are engaged in forwarding a science so exten-

sive and abstruse as philosophical botany, can command the time to become so familiar with the details of the commercial value of vegetable products, as to be safe referees on these subjects. On the other hand, it is equally a mistake to suppose that those who devote themselves to the collection of economic products, can possess the experience and botanical knowledge necessary to render their identifications of tropical plants trustworthy in the eyes of men of science. It is therefore as a strictly scientific work that we offer this commencement of the Flora Indica to the public, but though the advancement of abstract science is indeed its primary object, yet as we yield to none in our estimate of the value of economic botany, we confidently trust that . . . our labours will be found of material service."

"Had it been possible to take up the economic plants of India by themselves, and to present a history of them to the English reader, we should at once have devoted ourselves to the task, with the certainty of obtaining an amount of encouragement which a so-called paying work is sure to command, but which one of a more scientific nature is not thought worthy of receiving. We should, however, only be deceiving the public, were we to propose a scheme which, in the present deplorably backward state of scientific Indian botany on the one hand, and the confusion of Indian economic botany on the other, is literally impracticable: the difficulties have increased fourfold, from scientific botany not having advanced *pari passu* with the economic branch; and so long as plants themselves remain undescribed, it is obviously impossible to recognize what are useful, or so to define them that they shall be known by characters that contrast with those of the useless. Our principal aim, however, being purely botanical, the most insignificant and useless weed is as much the object of our attention as the Teak, Sal, and tea: in the vegetable kingdom, and in the great scheme of nature, all have equal claims on our notice, and no one can predicate of any, its uselessness in an economic point of view."

"Every one who has studied Indian plants, whether for economic purposes or for those of abstract science, must have felt the want of a general work which should include the labours of all Indian botanists, to be a very serious inconvenience. Our own experience in India has convinced us of this; for we found it often impossible to determine the names of many of the most ordinary, and, in an economic point of view, often most valuable forms; and every day's additional experience in the preparation of this volume has served to show more and more clearly, that whilst such a work is wanting satisfactory progress is impossible. At present the student has to search in general systematic works, for the descriptions of species; and as all of these are imperfect, a multitude of scattered papers must be consulted for the additions which have from time to time been made. These too have unfortunately so often been published without reference to preceding works of a similar nature, that the same plant has been described as new by

(1) HOOKER & THOMSON, *Flora Indica* (1855) 1-280, specially p. 3 *et seq.*

many successive botanists, ignorant or neglectful of the labours of their predecessors." So far HOOKER.

To emphasize our inability to foresee practical results of taxonomic work I intend to mention a few recent instances in Malaysia showing that plants which seem useless at the present may stand in the focus of attention at a future date.

Twenty years ago it would have seemed the whim of a botanist to work on the species of a genus of foetid aroids, scientifically known as *Amorphophallus*. Few years later, however, the tubers of some species of this genus were found to be important commercially and industrially. The basic work on the distinction of the species, the notes on their distribution, their habit and structure proved to be most useful for agricultural purposes.

The same holds for a genus of leguminous plants, *Derris*. The roots were found to contain a very valuable resin-like substance, rotenon, poison to fish and numerous insects but harmless to larger animals, also to man. As soon as its commercial value was recognized a sudden large demand for *Derris* rose. It soon appeared that not every species was valuable and so the original studies of *Derris* offered hold for a first segregation of promising material whereas the systematist was questioned about the characters by which the species could be recognized.

The absence of any reliable taxonomic information of the genus *Metroxylon* prevents at present well-founded research on the economic possibilities of the sago-producing species which supply a basic food to the whole population of East Malaysia and Melanesia.

Invariably it is the duty of the taxonomic botanist to supply *basic data* to research in directed (= applied) botany.

In all cases the *name of the species*, and eventually its varieties, is the *alpha of knowledge*, as it represents the key to existing literature embodying earlier work on habits, life-history, on distribution geographical and altitudinal, ecology and growth habit, current native names if any, etc. and Flora Malesiana must serve for this purpose.

In the past e.g. tropical plant-breeding in some cases followed a wrong direction and might have achieved better results more rapidly when the aid of taxonomists had been available or requested.

From the discussion of some selected topics above it will be clear that the taxonomic botanist in composing the Flora Malesiana will be able to offer critical knowledge of numerous *forest products*, plants containing *vegetable oils, fats, and resins, rattan, timber, gums, fruits, spices, insecticides, fibres, dyes, and medicines*, or species which may serve for *afforestation*, for *ornamental use*, as *new green manures, fodder plants*, or possibly, *species withstanding drought* or being *resistant to fire or inundation*, suitable for *combating erosion*, and other economic aspects.

In addition to taxonomical information, the Flora Malesiana will contain ecological data. In anthropogenic areas and eroded lands biological control of necessity will seek guidance in its comprehensive survey of facts. Large amounts of money

and energy have been wasted in the absence of professional planning, through negligence of fundamentals. I remember attempts, as expensive as they were fruitless, of planting mangroves to protect the coastal area of a tropical harbour, a waste which would have been avoided when the ecological potentialities of mangrove forest had been duly considered.<sup>1</sup>

In (re-)afforestation, the choice of trees has to rely partly on previous experience, but directions can be given by field-taxonomists and by means of general rules of tolerance capacities. Native trees occupy in our forest-types fitting ecological niches, but it should not be assumed that they grow always under optimal conditions. An example is probably found in swamp forest trees which have roots tolerant of a very low aeration of the soil, a virtue not practically utilized, as far as I know, when planting on very poorly aerated soils.

The ecological misunderstanding that all plants grow in nature under optimal conditions for their growth led to 'forest plantations' of quinine by JUNGHUHN. The *Cinchona*-crop was saved thanks to TEYSMANN who maintained that the plant should be grown in the open. Much trouble and still much more money could have been saved if this ecological principle had been better known.

The Flora Malesiana is, therefore, of first interest to practice and may direct new research: it must give data as to where the plant occurs, in what quantity, under what life-conditions, and with what life-cycle. It ought to contain ecological and biological data, and a critical extract of the notes made by the collectors. None of us can predict the industrial future of a neglected plant species, but we should be prepared for any coming rush on the botanical wealth of this vast archipelago, linking the Asiatic and Australian continents.

The aim of the Flora Malesiana is to compile a critical knowledge and a botanical standardization of the Malaysian flora of basic importance both to pure and to economic botany.

**How much of the flora is known?** Often it is assumed—the majority of botanists being acquainted with the state of knowledge in Europe or North America—that the flora of these islands is sufficiently known, and the actual facts cause astonishment.

For instance, not even the number of species is known otherwise than by very approximate calculation; 25,000 to 30,000 species of flowering plants is a conservative estimate. The *Orchidaceae* alone claim about 5000 species. Java possesses more than 500 species of ferns. The number of different species of trees in Malaysia is about 3000. The total number of genera is near 2400. The largest genera are found among the Orchids, *Dendrobium* with ca 1110 and *Bulbophyllum* with about 933 recognized species.

This is indeed astonishing if compared with the flora of Holland where the whole native flora

(1) Kustaanwas en mangrove (Natuurwet. Tijdschr. Ned. Ind. 101 (1941) 82–85).

amounts to little more than 1000 flowering plants.

Counting all trustworthy and up to date revisions together, about 5000 out of a total of 25,000–30,000 species are now more or less critically known. It appears that the bulk of the work remains still to be done.

The area covered by the *Flora Malesiana* will besides Indonesia also include the Malay Peninsula, Sarawak, Brunei & British North Borneo, the Philippines, Christmas Island, Portuguese Timor, and the whole of New Guinea (fig. 1).

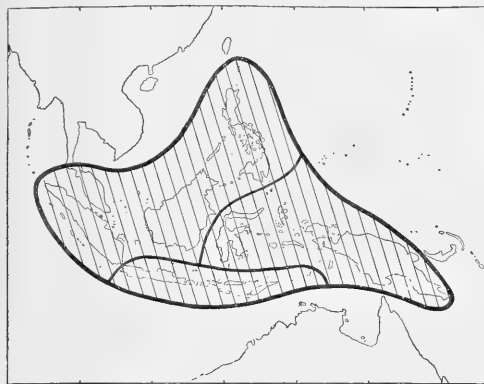


Fig. 1. Delimitation and main divisions of the flora of Malaysia.

It may be asked whether this is not an unnecessary extension of the task to include foreign border countries. To explain this it ought to be realized that the demarcation lines of natural units seldom coincide with political boundaries.

As much as possible, however, the demarcation of a Flora should be based on scientific, that is, plant geographical limits.

Plant geographically the natural demarcation lines of the Malaysian flora pass through the isthmus of Kra, between the Philippines and Formosa, and through Torres Straits, and include the Louisiades and the Bismarck Archipelago. An extensive geographical survey of the distribution of the Malaysian flora will be published in the 3rd volume of this work. The outcome<sup>1</sup> is wholly in confirmation with the suggested demarcation lines which were drawn first, as I have mentioned, about a century ago by ZOLLINGER.<sup>2</sup>

In the NW quite a number of typical Malaysian genera of forest plants fail to occur any further in the Indochinese Peninsula, e.g. *Rafflesia*, *Rhizophora*, *camphorwood* (*Dryobalanops*), *benzoin* (*Styrax benzoin*), *kauri* or *copal* (*Agathis*), *true ironwood* (*Eusideroxylon*), *menggaris* (*Koompassia*), etc.

The Philippines possess an essentially Malaysian flora, in contrast to Formosa's Japano-Chinese

floral character which was definitely demonstrated by MERRILL.<sup>3</sup>

The flora of New Guinea was formerly assumed to be essentially Australian in character. This interpretation was mostly based on zoological arguments and on the occurrence of few but very striking examples of plants which later appeared to be also spread westwards in the Moluccas and Celebes. O. WARBURG, in 1891,<sup>4</sup> on account of important statistics, already showed the essential Malaysian character of the Papuan flora.

Technically the botanist must in *each* case—whether the Flora Malesiana is limited to a political or to a natural demarcation—study and compare critically all species of the natural phyto-geographical unit. Plants described hitherto only from East New Guinea almost certainly occur also in West New Guinea, numerous species originally described from the Philippines occur in Celebes, the Moluccas and New Guinea, and the same holds for the Malay Peninsula, where the flora is intimately allied to that of Sumatra and Borneo. In identifying plants of Malaysia in the narrow sense, that is, limited to the Netherlands Indian boundaries, the botanist is always obliged to revise or critically to take into consideration the species described from the border areas. This will cost him about the same time and labour as when admitting them into the final work.

If these species are omitted, the Flora Malesiana will doubtless be out of date early and unnecessarily.

#### Bibliographic advantage of the Flora Malesiana.

The absence of any definitely indicated centre of publication for Malaysian plants has led to a rather chaotic taxonomic literature. At the present moment revisions of Malaysian plants are published more or less frequently in about 10 important periodicals scattered all over the world, and occasional publications are found in some 50 others. An annotated list of former revisions will be presented in this volume to facilitate future study. No single individual can be supposed to own these journals and it is thus more or less private knowledge to those, who have access to a well-stocked library. In Malaysia there are only two libraries where they are nearly all represented, viz at Buitenzorg and Singapore.

This is of course a rather unsatisfactory situation to naturalists, foresters, agriculturists, phytochemists, veterinarians, pharmacologists, and interested private persons desirous to study the flora according to the best available data. The Flora Malesiana will put students of systematic botany generally in possession of the essence of literature.

**Sequence of publication.** It is commonly understood that in a flora the sequence of publication ought to be in agreement with the 'natural system'. This has been—I feel sure—a serious obstacle mentally and practically to all those who, previously, have considered the project of this flora.

Arguments against this sequence are in the first

(1) Tijdschr. Kon. Ned. Aandr. Gen. 65 (1948) 193–207, 7 fig.

(2) Natuurk. Tijdschr. Ned. Ind. 13 (1857) 293–322.

(3) Bot. Jahrb. 58 (1923) 599–604.

(4) Bot. Jahrb. 13 (1891) 230–455.

place the existence of several 'natural systems'; it is tacitly agreed that the last word in 'the natural system' will probably never be spoken.

A system now adopted may be obsolete when this flora is finished.

A choice seems, therefore, difficult, as most of the systems are advanced by leading botanists who among themselves, may claim little priority of preference.

It would be possible that the editors of the Flora Malesiana advance a system of their own. However, this falls beyond the scope of this Flora which is solely intended as a practical work.

This technical difficulty, which was already mentioned on p. viii, in connection with the adoption of a system is a serious obstacle to the progress of the work.

Clearly not at every moment a specialist is available for every family of flowering plants. This is more or less a matter of chance. Rapid and regular publication is most desirable and so every opportunity should be made use of. A 'natural system' consequently involves the 'waiting' of some manuscripts for many years because it is not yet their turn to be printed, and several volumes will be set up in one part but can be continued only at a remote period because for the 'following' family no specialist was available. The real disadvantage can be observed in works like the *Flora of North America*, in course of publication, of which, in 1941, were published 2 complete volumes and 55 loose parts belonging to 17 of the remaining 32 planned volumes. The same has been the case with the *Flore Générale de l'Indo-Chine* where most volumes ranged over a period of about 30 years before they were completed and could be bound. In the meantime consultation was very difficult because the indexes appeared naturally in the final instalment. The handling of the loose parts is undesirable both from a bibliographical and a practical standpoint.

In the newly started *Flore de Madagascar* the families are numbered according to the natural system and are separately published and paged. The idea is that after completion the subscribers can arrange them into sequence and bind them accordingly. We must be aware, however, that this will hardly bring any advantage as the number of families in the Malaysian flora is 211, and that among them 70 families are represented by less than about 10 species, so that also in this case one has to handle a large amount of small unbound fascicles.

A long time is needed to complete the *Flora Malesiana*, about 25 years at least.<sup>1</sup> This is certainly not overestimated if compared with floras of similar magnitude as *Flora Brasiliensis* (1840-1906), *Flora of Tropical Africa* (1868-hodie), *Flora Capensis* (1894-1933), *Flora of British India* (1855-1897), *Flore générale de l'Indo-Chine* (1907-hodie), *Flora Australiensis* (1863-1878).

The exact duration cannot be calculated, this

(1) Under the most favourable conditions as regards funds, and co-operation.

depends largely on opportunity and facilities, and the joining of forces. The editors are fortunate in having received the promise of much co-operation, and they hope to be able to extend their resources still more. Moreover a considerable amount of recent publications exists which may easily be adapted to the flora.

The here adopted scheme of 'opportunity sequence' in the production of family revisions will remove any delay caused by the 'natural system'. The addition of an up to date index to the contents of prior parts on the cover of each new appearing instalment will serve to verify in a moment if a desired group has already been revised.

The size of the families is of course widely different ranging from 1-5000 species.

At least one figure illustrating characteristics will be added to each family and large genus.

The volumes will not exceed 500-600 printed pages. They must be easy in the hand, agreeable to work with, and bound in covers which may not be attacked by tropical insects, as we hope that numerous subscribers will be found in the Old World tropics outside the official institutions.

**Completeness of the Flora.** No perfection can ever be attained in any tropical flora. Always novelties and new localities will have to be recorded. No squadron of botanists can ever comb a tropical area engirdling  $\frac{1}{7}$  of the equator.

Although completeness is a first aim set for this work, its future value will depend mainly on the amount of critical original study which it contains. The Floras of British India<sup>2</sup> and Australia are now definitely incomplete, but they remain first class sources of information. BACKER's *Schoolflora voor Java*, of 1911, still meets present demands nearly as well as at the time of its appearance. If we can keep our flora to so high a standard it will become the keystone to future Malaysian systematic botany.

The Flora Malesiana will be started with the flowering plants (*Series I*).

*Series II* will comprise the ferns and fern allies and is estimated to occupy 3 volumes.

*Series III* will be devoted to mosses and hepatics. These will take about 5 volumes.

*Series IV* will treat the fungi and lichens. The number of volumes can as yet not be estimated.

*Series V* is intended for the algae and other groups of unicellular cryptogams.

For the series II-V special editors will be appointed. The general method of treatment may possibly deviate somewhat from the first and largest series but the needs of these can hardly be estimated at the moment.

C. G. G. J. VAN STEENIS

Buitenzorg/The Hague, Sept. '44/July '47.

(2) Dr K. BISWAS calculated that to the 'Flora of British India' consisting of ca 14000 species, ca 2000 have been added since its publication, a surprisingly low number in relation to its vast surface and variety of vegetation types (Proc. 30th I.S.C. pt II, sect. V, Bot., Pres. addr. p. 109).

# GENERAL CONSIDERATIONS

*We should endeavour to determine how few, not how many species are comprised in the Malaysian flora.*

In writing the following chapters I have kept in mind the exemplary 'Introductory Essay' of J. D. HOOKER in his 'Flora Indica' (1855), the precursor of the 'Flora of British India'.

For the same reasons that moved HOOKER, I felt obliged to introduce the Flora Malesiana proper by some general considerations especially intended for co-operators less fortunate than I have been in acquiring an experience of long standing in the field. I may add that field experience often is invaluable when studying dried, always fragmentary, materials in the Herbarium.

Some of the subjects HOOKER treated are now too large to be included in one essay and, therefore, the *survey of the Malaysian collections*, the *physiognomy of the vegetation*, and the *genetic and floristic plant geography* occupy the (introductory) volumes 1-3 of this work.

The present essay will be entirely devoted to topics directly bearing on the study of systematic botany. Some of them I have previously discussed, or touched on, in my study of the origin of the Malaysian mountain flora.<sup>1</sup>

As my intention is to further the study of Malaysian botany, I shall discuss only points of which a clear understanding is essential to the Malaysian naturalist. I will try to illustrate each case by reference to plants of this region.

These points are: *individual variation and racial segregation, variation caused by the environment, the problem of speciation and specific centres, hybridization, views on the status of the species and subspecies, migration and adaptation*, and the way to interpret these concepts.

These theoretical points are inseparable from a philosophical study of plants, and I believe it to be essential for systematists to explain the principles which have guided them in the execution and design of their work.

HOOKER's general instructions have guided me in my work, and I am convinced that in the *flux* of botanical conceptions in general aspects the words of the Master still hold their own. I desire to express here my admiration for this classic work by quoting *literatim* some passages of his essay.

"It may seem almost chimerical to look forward to a time when all the species of the vegetable world shall have been classified upon philosophical principles, and accurately defined; and it must be confessed that the present state of descriptive botany does not hold out much prospect of the realization of so very desirable an object. This, we think, is in a great measure due, not to any want of students willing and anxious to take up the subject, but rather to a gradually increasing misapprehension of the true aim and paramount importance of systematic botany, and of the proper mode of pursuing the study of the laws that govern the affinities of plants. We are therefore desirous, at the outset of a work which is devoted to these subjects,

of explaining our views on them; and as we trust that our work will fall into the hands of many beginners who are anxious to devote themselves usefully to the furtherance of botanical science, but who have not an opportunity of acquiring in any other way its fundamental principles, we shall make no excuse for dwelling at some length on the subject. We are also anxious to refute the too common opinion (which has been productive of much injury to the progress of botany) that the study of systems presents no difficulties, and that descriptive botany may be undertaken by any one who has acquired a tolerable familiarity with the use of terms."

"There can be no doubt that any observant person may readily acquire such a knowledge of external characters, as will in a short time enable him to refer a considerable number of plants to their natural orders; though even for this first step more knowledge of principles is required, than to make an equal advance in the animal kingdom: but to go beyond this,—to develop the principles of classification, to refer new and obscure forms to their proper places in the system, to define natural groups and even species on philosophical grounds, and to express their relations by characters of real value and with a proper degree of precision, demands a knowledge of morphology and anatomy and often of physiology, which must be completely at command, so as to be brought to bear, when necessary, upon each individual organ of every species in the group under consideration. To follow the laws that regulate the growth of all parts of the plant, especially the structure of stems, the functions of leaves, the development and arrest of floral organs, and the form, position, and minute anatomy of the pollen and ovule, and to trace the whole progress of the ovule and its integuments to their perfect state in the seed, ought all to be familiar processes to the systematic botanist who proceeds upon safe principles; but no progress can be made by him who confines his attention chiefly to the modification of these organs in individual or natural orders."—So far HOOKER.

Variability in characters of minor importance and description of extreme forms have led to a rather confused state of affairs. I believe that among the scores of species described many microspecies should be reduced to a much smaller number of true species, with a normal area of distribution and a normal variability in characters typical for Linnean populations which are intermediate between the species of extreme 'splitters' and extreme 'lumpers'. Much 'splitting' has been caused by describing single extreme forms not exactly agreeing with the type or type-description; for practical purposes it is sometimes required to describe such forms as new species and to recognize them provisionally as new 'entities'; the author's conscience and eagerness to finish his task are thus temporarily satisfied. This method has proved a failure and a serious handicap to the progress of tropical plant knowledge.

(1) Bull. Jard. Bot. Btzg III, 13 (1935) 358-407.



There are three methods of handling new collections, all being equally unsatisfactory. Firstly, provisional rapid identification of the material as to genus, or to species as far as is possible, and its insertion in the herbarium; collectors in general do not favour this method as only few final names can be provided on a cursory examination. Secondly, a collection may be worked through by rough comparisons to named specimens and with standard literature. This second method is rapid but all extreme forms and forms belonging to large genera or to difficult families which cannot be identified from the available literature, are described as new (*specimen description*). By this method collectors get immediate results but science is burdened with a host of 'endemic' species which, as experience has shown, disappear by the score when a thorough monograph is made. Thirdly, a collection may be thoroughly studied, delaying results, as the identification of extremes means in nearly every genus a preliminary revision.

HOOKEER continues (*l.c.*):—"A knowledge of the relative importance of characters can only be acquired by long study; and without a due appreciation of their value, no natural group can be defined. Hence many of the new genera which are daily added to our lists rest upon trivial characters, and have no equality with those already in existence. A proneness to imitation leads to a gradual increase in their numbers, without a corresponding increase of sectional groups. Indeed, even when the sectional groups are well defined, and the genera in themselves natural, a too great increase in the number of genera is detrimental, by keeping out of view those higher divisions which are of greater importance. The modern system of elevating every minor group, however trifling the characters by which it is distinguished, to the rank of a genus, evinces, we think, a want of appreciation of the true value of classification. The genus is the group which, in consequence of our system of nomenclature, is kept most prominently before the mind, and which has therefore most importance attached to it."<sup>1</sup>

(1) "We may make our meaning more clear by a few examples. The genus *Ficus* is surely more natural than the subgenera *Pogonotrophe*, *Covellia*, *Urostigma*, &c, into which it has been subdivided. So with the genera *Anemone*, *Hedyotis*, *Erica*, *Andromeda*, and others which have been split into many by modern systematists." R. BROWN, G. BENTHAM, J. D. HOOKER and others, in all their works, laboured to keep this important principle in view, and to impress it upon others; they have, however, failed to check the prevalent tendency to the multiplication of genera.

I add here other examples of genera occurring in Malaysia which are separated by trifling characters: *Voandzeia* differs from *Vigna* only in fruit biology, viz its globular pods ripening subterraneously. In *Urena* and *Pavonia* now only one fruit character remains the decisive distinction, *Dillenia* and *Wormia* are distinguished only in their fruit biology, *Berberis* and *Mahonia* are distinct solely in the foliage, *Kibessia* and *Pternandra* differ only

"The rashness of some botanists is productive of still more detrimental effects to the science in the case of species; for though a beginner may pause before venturing to institute a genus, it rarely enters into his head to hesitate before proposing a new species. Hence the difficulty of determining synonymy is now the greatest obstacle to the progress of systematic botany; and this *incubus* unfortunately increases from day to day, threatening at no very distant period so to encumber the science,<sup>2</sup> that a violent effort will be necessary on the part of those who have its interests at heart, to relieve it of a load which materially retards its advancement. The number of species described is now so very great, and the descriptions are scattered through such a multitude of books, that even after long research it is difficult to avoid overlooking much that is already known; and when botanists with limited libraries and herbaria institute new species, it is almost certain that the latter will be found to have been already characterized. To such an extent is this carried, that we could indicate several works, in which one half and even more of the species are proposed in ignorance of the labours of other botanists. Indian Botany unfortunately, far from forming an honourable exception in this particular, presents a perfect chaos of new names for well-known plants, and inaccurate or incomplete descriptions of new ones".

"It must be remembered too that the Linnean canon, by which twelve words were allowed for a specific character, is now becoming quite inadequate to the requirements of the science; and that the brief descriptions, which are now so generally substituted for definitions, unless prepared with the greatest skill, as well as care, and after an inspection of very numerous specimens, seldom express accurately the essential characters of a plant. It is indeed becoming more and more evident, that in the great majority of instances no definition is sufficient to enable inexperienced botanists to determine with accuracy the species of a plant, even when the whole genus is well known; much more is this the case in genera, many of whose species are yet undiscovered; and most of all, in those where the forms, though sufficiently well known, are liable to much variation. In the last case their determination becomes a special study;

in unimportant characters of the calyx tube, etc. The separating characters are far less important than those which, in other genera, serve to divide sections or subgenera.

The more species are described the more differences originally accepted as of generic rank tend to disappear. A redefinition of the generic characters is often delayed, and the attitude in 'local-monographs' is mostly to keep at all costs the old delimitation in order to avoid laborious monographic work. Suggestive casual remarks are often made in local works, but decisions deferred.

(2) In entomology this has led to an intolerable chaos (*cf.* The New Systematics 1940, p. 475-491). The same holds for several large groups of the Fungi.

and when attempted without access to authentic specimens, leads to inextricable confusion, and its evil effects are not confined to specific botany, but extend to all departments."

"The pages of our Indian Flora will supply numerous illustrations of these remarks, and we would direct the attention of those commencing the study to the lesson to be derived from these instructive errors; for where the first botanists of the day have failed, beginners cannot be expected to succeed. It cannot be too strongly impressed upon all students of botany, that it is only after much preliminary study, and with the aids of a complete library, and an herbarium containing authentic specimens of a very large proportion of known species, that descriptive botany can be effectively carried out; and it would be well for science if this were fully understood and acted upon."

"The prevailing tendency on the part of students of all branches of natural history, to exaggerate the number of species, and to separate accidental forms by trifling characters, is, we think, clearly traceable to the want of early training in accurate observation, and of proper instruction in the objects and aim of natural science. Students are not taught to systematize on broad grounds and sound principles, though this is one of the most difficult processes, requiring great judgement and caution; or, what is worse, they are led by the example if not by the precepts of their teachers, to regard generic and specific distinctions as things of little importance, to be fixed by arbitrary characters, or according to accidental circumstances. As a consequence, the study of systematic botany is gradually taking a lower and lower place in our schools; and, being abandoned by many of those who are best qualified to do it justice, it falls into the hands of a class of naturalists, whose ideas seldom rise above species, and who, by what has well been called *hair-splitting*, tend to bring the study of these into disrepute."

"We therefore earnestly recommend to the Indian botanist the detailed study of individuals and their organs with the view of determining their limits of variation."

WIGHT and ARNOTT<sup>1</sup> formulated their warning to beginners as follows:—

"We shall perhaps be severely censured for cutting down species. We have all along considered it as trifling with nature to separate species on slight or variable grounds, nor could we ever understand the '*cui bono*' for which so much ingenuity in splitting hairs has been wasted. Before we determined what was a species, we examined with care numerous specimens from the same and different localities; and so far we have had an advantage over many other of the European botanists who have described Indian plants, they having only seen one or two isolated specimens. Numerous observations too were made in the plants in their natural situation, the result of which went to prove, what we have frequently endeavoured to enforce by

examples throughout the present volume, that no precise shape of leaf or quantity of pubescence is of any value, although both of these seem in each species to be limited within certain variations. With regard to varieties, we have seldom distinguished any unless well marked and tolerably constant; we are aware, indeed, that these correspond to what some naturalists call species, but our own observations have convinced us, that varieties and forms, as well as species, may be constant in similar situations, and even in widely different situations, for many years, if raised from seeds either obtained from the original locality or from cultivated plants; the cultivated cerealia and garden vegetables ought to lead to such an hypothesis without any additional proof." So far WIGHT and ARNOTT.

HOOKER continues:—

"In relative size especially, the observer will find immense variation; for, unlike the animal creation, proportional dimensions are of small moment in the vegetable kingdom. This fact, so familiar to the botanist of experience, is always a puzzle to the zoologist, who fancies he perceives a vagueness and want of exactness in all botanical writings (except in those of the too numerous class that make a parade of measuring to lines organs that vary inches), that contrasts unfavourably with descriptive zoology. Symmetry is again only a relative term amongst plants, for even such leaves as grow in pairs are never alike, and often differ much in form, texture, and colour; whilst the various sepals, petals, *etc.* of an individual flower, never so exactly correspond as the relative members of an animal do; and there are still greater differences between these organs, when taken from different flowers."

"It is hardly necessary to allude to the desirability of studying the various forms induced by artificial causes: the browsing of cattle on shrubs, for instance, which is almost invariably followed, by an abnormal state of foliage on the subsequently developed shoots, has been a prolific source of bad species; while there is scarcely an operation of man that does not tend to produce change in the vegetation surrounding him."

"It will generally be found that botanists who confine their attention to the vegetation of a circumscribed area, take a much more contracted view of the limits of species, than those who extend their investigations over the whole surface of the globe. This is partly, no doubt, owing to the force of bad example; and partly to the fact that the student who takes up the study of the flora of his native country, finds that the species are all tolerably well known, and that no novelty is to be discovered. There is therefore a natural tendency to make use of trifling differences, from the scope which they afford for minute observation and critical disquisition; whilst the more close comparison of the few species which come under his investigation, leads the local botanist to attach undue importance to differences which the experienced observer knows may be safely attributed to local circumstances. To this tendency there can be no limit, when the philosophy of system is not understood; the distinctions which appeared trifling to

(1) Prod. Fl. Pen. Ind. Or. 1 (1834) p. xxxi.

botanists a quarter of a century ago, are at the present day so magnified by this class of observers, that they constantly discover novelties in regions which have been thoroughly well explored; considering as such, forms with which our predecessors were well acquainted, and which they rightly regarded as varieties.<sup>1</sup>

"Another result of the depreciated state of systematic botany is, that intelligent students, being repelled by the puerilities which they everywhere encounter, and which impede their progress, turn their attention to physiology before they have acquired even the rudiments of classification, or an elementary practical acquaintance with the characters of the natural orders of plants. Unfortunately, in botany, as in every other branch of natural science, no progress can be made in the study of the vital phenomena except the observer have a previous accurate acquaintance with the various modifications under which the individual organs of plants appear in the different natural orders, and such an appreciation of the comparative value, structural and morphological of these modifications, as can only be obtained by a careful study of the affinities of their genera and species. Ignorance of these general laws leads to misinterpretation of the phenomena investigated by the physiologist, and to that confusion of ideas which is so conspicuous in the writing of some of the astute physiological observers of the day."

"The modern system of botanical instruction attempts far too much in a very limited space of time, and sends the student forth so insufficiently grounded in any branch of the science, that he is unprepared for the difficulties which he encounters, let his desire to progress be ever so great. The history of botanical discovery, and the philosophy of its advance, form instructive chapters for the student in any department of natural science."

"We owe to LINNAEUS the establishment of the doctrine of the sexuality of plants; and we find by the writings of the same great naturalist, that besides foreseeing many physiological discoveries, he preceded GOETHE in the discovery of morphology, a doctrine which, more than any other, has tended to advance scientific botany. A third great discovery, that of the nature of the ovule, and the relation of the pollentube to the ovary, received its principal illustration at the hands of BROWN, our chief English systematist, and of BRONGNIART, also a practised botanist."

"It should not be forgotten, that the relative importance of physiology is very different in the animal and vegetable kingdoms. In the former, structure and function operate so directly upon one another, that the great groups are, to a certain extent, defined by well-marked external characters, which are at once recognizable by the student, and are familiar, or at least intelligible, to those even

who have paid no attention to natural history. In the vegetable kingdom this is by no means the case: the processes of assimilation and secretion present but little of that complication which renders the study of animal physiology so important; they are, on the contrary, uniform almost throughout its whole extent, and moreover so simple in their *modus operandi*, that this very simplicity prevents their being rightly understood. In consequence, even the two great classes of Monocotyledons and Dicotyledons are not distinguishable without considerable practice and study; and were we dependent upon actual inspection of the organs whence the essential characters of these groups are drawn, for the means of recognizing, Systematic Botany would be an impracticable study."

"Herein lies one great obstacle which meets the beginner on the very threshold of his botanical studies: he sees the great divisions of the animal kingdom to be recognizable by mere inspection, and that familiar characters are also natural, and available for purposes of classification: the very names of the groups convey definite information, and to a great extent give exact ideas. Birds, fishes, reptiles, *etc.* are all as natural as they are popular divisions; but what have we in the vegetable kingdom to guide the student through the two hundred and fifty natural orders of flowering-plants? As with a new language, he must begin from the very beginning, and also avail himself of artificial means to procure as much superficial knowledge of structure and affinity as shall enable him to see that there is a way through the maze. Hence the obvious necessity of an artificial system of some sort to the beginner, who has, at the same time, to master a terminology, which, if not so complex as that of zoology, is more difficult at the outset, from the want of standards of comparison between the organs of plants and those he is familiar with in himself as a member of the sister kingdom. Applying these remarks to practice, the botanical student finds that he has much to unlearn at the very outset; in many cases he has misapplied the terms root, stem, leaf, *etc.*, and contracted most erroneous ideas of their structure and functions; while he is startled to find that the popular divisions of plants into trees, shrubs, and herbs, —leafy and leafless, water and land, erect, climbing, or creeping,—are valueless even as guides to the elements of the science."

"It is not however to be supposed, because pure physiology is of secondary importance to the right understanding of the affinities of plants, that botany is therefore a less noble or philosophical study than zoology; since we find anatomy, development, and morphology, occupying a very far higher rank in proportion. Being deprived, as he is in most cases, of all technical aids to the determination even of the commoner exotic natural families, the systematist is compelled to commence with the knife and microscope, and can never relinquish these implements. Systematic Botany is indeed based upon development; and no one can peruse, however carelessly, the most terse diagnosis of a natural order or genus of plants, without being

(1) "Many of the species which have been revived in modern times were indicated by HALLER, RAY, TOURNEFORT, and other ancient botanists, but were reduced to the rank of varieties, when the science was reformed by LINNAEUS."

struck with the variety and extent of knowledge embodied as *essential* to its definition and recognition. Not only are the situation and form, division or multiplication, relative arrest or growth, of the individual organs exactly defined, in strictly scientific and scrupulously accurate language, but the development of each is recorded from an early stage: the veneration and stipulation of the leaves; the aestivation of the young calyx and corolla, and their duration relatively to other organs; the development and cohesion of the stamens; the position and insertion of the anther; its pollen; the cohesion or separation of the carpels, and the stages of their development from the bud to the mature fruit, and from the ovule to the ripe seed, are all essential points; all however minute, must in many cases be actually inspected before the position of a doubtful genus can be ascertained in the Natural System; and this is not the exception, but the rule."

"The necessity for acquiring so extensive and detailed a knowledge indicates a power of variation in those organs from which the natural characters are drawn, that defeats any attempt to render one, or a few of them only, available for the purposes of classification; and hence it is that the study of morphology or the homologies of the organs, becomes indispensable to the systematist; by this he reduces all anomalies to a common type, tests the value of characters, and develops new affinities. The number, form, and relative positions of organs may supply technical characters, by which observers of experience recognize those natural orders under which a great number of plants arrange themselves; but a knowledge of structure and anatomy alone enable the botanist to progress beyond this, and to define rigidly: whilst the study of development affords him safe principles upon which to systematize and detect affinities, and morphology supplies the means of testing the value of the results, and reveals the harmony that reigns throughout the whole vegetable world."

"Physiology, again, is a branch of botany very much apart from these: its aim is the noblest of all, being the elucidation of the laws that regulate the vital functions of plants. The botanical student of the present day, however, is too often taught to think that getting up the obscure and disputed speculative details of physiology, is the most useful elementary information he can obtain during the short period that is given him to devote to botany; and that, if to this he adds the scrutiny of a few of the points under a microscope, he has made real progress as an observer. This, we maintain, is no more botany, than performing chemical experiments is chemistry, or star-gazing astronomy. A sound elementary knowledge of vegetable physiology is essential to the naturalist, and should indeed be a branch of general education, as it requires nothing but fair powers of observation and an ordinary memory to acquire it. For the student to confine his attention to this knowledge of the vegetable world, and to try and improve upon it by crude experiments of his own, undertaken in ignorance of the branches of pure botany

we have enumerated, is a very rational amusement, but nothing more."

"The students are indeed, in too many cases, perfectly ignorant of the elements of natural science, and require some practical acquaintance with plants and their organs, before they can appreciate the relations of the different branches of botany to one another, or discriminate between what is essential to understand first, and what is better acquired afterwards. Were the elements of science taught at schools, this would not be so: we should then have the student presenting himself at the botanical lectures fully prepared for the more difficult branches of science, and for making that progress in them for which the professor's aid is indispensable. A sound practical knowledge of system we hold to be an essential preliminary to the study of the physiology of plants—a study which requires also a practical acquaintance with organic chemistry, consummate skill in handling the dissecting knife, and command over the microscope, a good eye, a steady hand, untiring perseverance, and above all, a discriminating judgment to check both eye, hand and instrument. A combination of these rare qualities makes the accomplished vegetable physiologist, and their indispensability gives physiology its pre-eminence in practice."

"It has been with no desire of obtruding our views upon our readers that we have ventured to discuss these obscure subjects with relation to Indian plants, but from a conviction, that in the present unsatisfactory state of systematic botany it is the duty of each systematist to explain the principles upon which he proceeds; and we do it not so much with the intention of arguing the subject, as of pointing out to students the many fundamental questions it involves, and the means of elucidating them."

"To every one who looks at all beneath the surface of descriptive botany, it cannot but be evident that the word *species* must have a totally different signification in the opinion of different naturalists; but what that signification is, seldom appears except inferentially. After having devoted much labour in attempting to unravel the so-called species of some descriptive botanist, we have sometimes been told that the author considers all species as arbitrary creations, that he has limited the forms he has called species by arbitrary characters, and that he considers it of no moment how many or how few he makes. So long as this opinion is founded on conviction, we can urge no reasonable objection against its adoption; but it is absolutely necessary that the principle should be avowed, and that those who think the contrary should not have to waste time in seeking for nature's laws in the works of naturalists who seek to bind nature by arbitrary laws. So again with regard to specific centres; except we are agreed with an author as to whether the same species has been created in one or more localities, and at one or more times, we shall be at cross purposes when discussing points and principles relating to identity of species and geographical distribution."

"Great differences of opinion have from the

earliest days of science always existed on the nature of species. The prevalent opinion has undoubtedly at all times been, that a species is a distinct creation, distinguishable from all others by certain permanent characters. Many eminent philosophers, however, have taken a contrary view; of these the best known have been LAMARCK, and more recently the anonymous author of the "Vestiges of Creation."—So far HOOKER.

Modern biological science has progressed rapidly in the last decades through the results of experimental genetics. Though it is far from easy to weld the often contradictory opinions into a satisfactory whole, views relating to matters of variation have much gained. In the following pages I will try to discuss on this new basis the value to be attributed to characters of less than specific importance and a number of considerations which may lead to increased accuracy in judging specific delimitation.

Trifling characters, such as *peloric* and *cleistogamous flowers*, have led to the creation of worthless new genera; *galls*, *insect bites*, and *parasitic fungi* have been mis-interpreted and caused the publication of new species of Phanerogams. *Individual variations*, either intrinsic or extrinsic have, in a similar way, induced systematists working on tropical plants to distinguish more species than Nature intended.

It is not our intention to limit phytography to a merely administrative function in the study of botany, but to treat it as an essential of natural philosophy. The systematist ought to keep pace with cytogenetics, physiology and morphology,<sup>1</sup> phytochemistry, phytogeography, ecology, genetics, *i. e.* experimental taxonomy.

Inadequate material<sup>2</sup> and information are the chief causes which prevent the phyto-systematist from applying the results obtained by these branches of botanical science.

The systematist is seldom favourably regarded by the layman or student of directed botany. They are opposed to changes in nomenclature, being unable to gauge the force of the arguments for a 'new' name for a familiar plant and so rarely accept the judgment of taxonomists. When, on the other hand taxonomic problems are tackled by applied scientists nomenclature and specific distinction become chaotic; entomology, mycology, forestry, agriculture and horticulture supply many examples. A wish for simplification, impatience, or even personal vanity or the desire for pecuniary gain have caused hosts of 'species' to be added to our lists

by applied workers. Not long ago a forestry officer made a study of *Agathis*<sup>3</sup> in Malaysia in which 13 species and 2 doubtful ones, that is 15 entities, were distinguished. In the same material the late Dr DANSER, whose judgment and experience cannot be doubted, distinguished only 3 divergent species with a number of local geographic variations. He found it very difficult to define the latter. Additional material showed that the keys and distinctions presented for the 13 species did not hold to the satisfaction of the Forest Research Station, from which this work emanated. In plant families of economic importance particularly in *Gramineae*, *Rutaceae*, and *Leguminosae*, similar work has resulted in multitudes of microspecies provided with binomials; by such a proceeding nothing is gained and much lost.

An example of the difficulties arising between taxonomy and an applied science when a good revision is absent, is the following:—a *Clausena* of unknown origin was cultivated for economic purposes at Buitenzorg. I referred it to *Clausena anisum-olens* (BLCO)MERR. but the phytochemist was dissatisfied, the properties of the oil did not tally with data recorded from the same species in the Philippines. I then sent ample material with full notes to Dr TANAKA, Dr SWINGLE, and to the Kew and Paris Herbaria, for identification. The answers were all different and the phytochemist was, of course, disgusted with the practical results of taxonomy, because now he had the choice among 5 names for his plant. By way of comfort I expressed the hope that a systematist would some day make a satisfactory monograph of the genus.<sup>4</sup> In order not to raise his hopes too high I remarked that even then some research from *him* would be needed to establish the assumed constancy of the oil properties as a specific character. I also informed him that taxonomy has sometimes scored by predicting phytochemical facts, *e.g.* when HALLIER supposed the presence of valerician acid in *Viburnum*<sup>5</sup> on phylogenetic grounds only.

In the following two chapters general information on variation as a source of superfluous binomials is collected for the benefit of those with no field experience of the Malaysian flora. I distinguish variations induced by the environment from those belonging to the genetic composition of populations, and I have tried to illustrate them by examples in Malaysian phytography.

Often the number of examples is too small, and chapters overlap, but in the course of time every student of Malaysian botany will meet with other equally telling cases. May they stimulate the wish to avoid lapses of this character by conscientious treatment of the revisions in Flora Malesiana.

(1) For the value of wood anatomy in taxonomy, see DEN BERGER, in Handel. 4e N.I. Natuurwet. Congres (1926) 397.

(2) Cf. WIGHT, in a letter to GRIFFITH, dated April 15, 1842:—"How people can work on dry plants I cannot imagine. I am daily convinced of the poverty of the study from such materials, unless a man has seen much of living structure." MIQUEL ignored this remark, and on sterile and inadequate material based a host of species from Sumatra which even at present are not wholly elucidated.

(3) Bull. Jard. Bot. Btzg III, 16 (1938) 455-474.

(4) Compare R. WIGHT in a letter to GRIFFITH, dated March 30, 1841:—". . . "as you say Botany is difficult, and increasingly so, but Botanists are to blame for this. No remedy will be so effectual as the publication of Monographs."

(5) Med. Rijksherb. Leiden no 14 (1912) 36; *ibid.* 37 (1918) 92. Cf. also *V. valerianoides* ELM.

# VARIATIONS MOSTLY INDUCED BY THE ENVIRONMENT

## (Phenotypic modifications)

Phenotypic modification is the response to environmental conditions, such as climate, soil, exposure, altitude, temperature, wind, fire and living organisms. The genetic qualities govern the character of the plant, but the environment in which the plant develops determines the actual and final appearance of the individual. The changes or differences from the 'normal plant' are called *modifications*. Such changed characters are not themselves inherited, however, though the manner in which a plant reacts to environmental conditions is. In some cases an external change may be reversed by a change in the environment during the development of the individual but in other cases, when factors act in the seedling stage only, the effects in the individual are irreversible.

It is necessary to agree about the concept 'normal plant'. This is far from easy, as each specimen grows under a different combination of CEB-factors (Climatic, Edaphic, Biotic). We might ap-

proach the idea by saying that "the normal plant results from a genetically average individual under average natural environmental conditions", average to be understood in the sense of optimal. This 'normal' individual is never a reality but remains an abstraction.

Though the difference between phenotypic and genotypic variation is clear, the field botanist—and still more the herbarium botanist—is not always able to recognize it. Only experiments may furnish proof. For instance a dwarf shrub in an area subject to fire or browsing animals may assume this stunted form through these CEB-factors but it is also possible that the stunted form is a specialized race adapted to these conditions and thus selected by nature itself from the specific population. Experimental breeding must decide its constancy.

I have arranged the phenotypic modifications under several headings—which partly overlap and interlock—in the following sequence:

Intrinsic	Ontogeno-morphosis	1. Juvenile forms . . . . .	p. xix
		2. Precocious flowering ( <i>paedogenesis</i> ) . . . . .	xxi
		3. Dimorphous foliage . . . . .	xxii
		4. Dimorphous seeds and fruits . . . . .	xxiv
	Teratologo-morphosis	5. Dimorphous flowers . . . . .	xxv
		6. Cleistogamous flowers . . . . .	xxv
		7. Teratological forms . . . . .	xxv
Climatic	Hypselo-morphosis	8. Phenotypic effect of altitude . . . . .	xxvi
	Photo-morphosis	9. Epiphytes . . . . .	xxviii
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	Hygro-morphosis	11. Influence of drought . . . . .	xxix
	Hora-morphosis	12. Seasonal variation . . . . .	xxix
	Anemo-morphosis	13. Wind forms . . . . .	xxx
Edaphic	Edapho-morphosis	14. Fumarole plants . . . . .	xxx
		15. Rock plants; calcareous and silicious soils . . . . .	xxxi
	Hydro-morphosis	16. Solfatara plants . . . . .	xxxiii
		17. Water and swamp plants . . . . .	xxxiv
Biotic	Phyto-morphosis	18. Fungus and bacterial diseases, and symbiosis . . . . .	xxxv
	Zoo-morphosis	19. Ant plants ( <i>myrmeco-morphosis</i> ) . . . . .	xxxv
		20. Galls deceptive to phyto-graphers ( <i>cecidio-morphosis</i> ) . . . . .	xxxvi
		21. Influence of browsing animals ( <i>pascuo-morphosis</i> ) . . . . .	xxxvi
	Anthropo-morphosis	22. Influence of fire ( <i>pyro-morphosis</i> ) . . . . .	xxxvii
		23. Pioneer plants . . . . .	xxxviii
		24. Savannah trees . . . . .	xxxviii

### Ontogeno-morphosis

#### 1. Juvenile forms

Juvenile forms often differ widely from the mature plant. Seedlings of many *Leguminosae* differ greatly from the adult in foliage and other characters. The youth form of *Cassia javanica* L. possesses large metamorphosed twigs acting as thorns (1). Thorny juvenile specimens are also found in *Alangium*.

In general, flowering twigs have smaller leaves than sterile branches; this often gives rise to diffi-

culty in identifying non-flowering material and is one of the pitfalls if new species are based on sterile material. An example is *Camposperma acutiauriss* BOERL. & KOORD. (*Anacardiaceae*) described on sterile juvenile material from Sumatra. The leaves are large and conspicuously auriculate-amplexicaulous. A similar juvenile form was later found in West Java, together with mature trees. These possessed much smaller non-auriculate leaves (fig. 2). The plant appeared to represent a species of *Tristania* (*Myrtaceae*) (2); its specific identity will probably remain obscure, however, as several species produce similar juvenile forms.

Youth forms of *Myrica longifolia* T. & B. differ strongly from mature specimens in possessing distinct stipules and incised larger leaves.

Incised leaves of seedlings occur in a score of arboreous plants, e.g. many *Bignoniaceae*, *Proteaceae*, *Gmelina*, *Lonicera*, *Alangium*, *Vitex*, &c. Leaves of young trees of *Pangium edule* REINW.

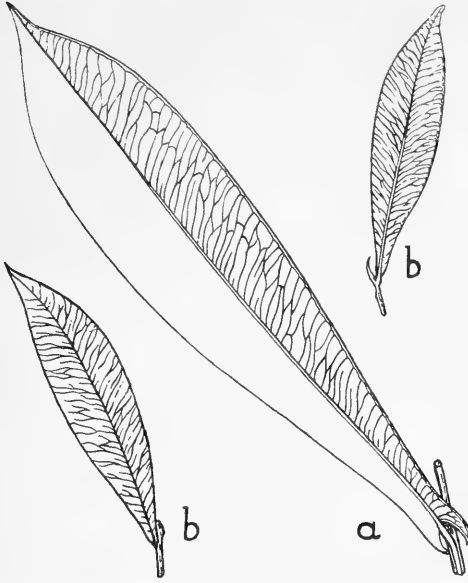


Fig. 2. Large leaf of a juvenile specimen, small leaves of a mature tree of *Tristania* sp. (Myrt.) in W. Java,  $\times 1/3$ .

are 3-lobed whereas the leaves of mature trees are entire.

The growth of different parts of the plant is often very disproportionate. In some *Symplocos* species I found the leaf teeth were mature and large in young leaves but inconspicuous in mature foliage: they possibly have some (?excretive) function during youth only. BACKER (3) found the leaf tip earlier developed than the blade in some species of *Dioscorea*; it disappears also sooner. A peculiar development occurs in the growing leaves of some *Meliaceae*, e.g. *Chisocheton* (fig. 3).

Very peculiar juvenile forms greatly differing from the later normal foliage, have been described in various climbing plants such as some spp. of *Adenia*, *Medinilla*, *Macrozanonia*, *Piper*, *Araceae*, *Ficus*, &c. Juvenile specimens of these trunk climbers are always sterile. Their foliage is mostly broader than that of mature plants, and is appressed to rocks or tree trunks. The similarity in their appearance may cause considerable confusion as e.g. is shown by the type specimen of *Ficus peltata* BL. which was recently proved to represent a juvenile specimen of some climbing species of *Piper*.

In several *Malvaceae*, *Leguminosae*, *Sterculiaceae*, *Tiliaceae*, juvenile leaves are often different

from mature ones (fig. 4). *Sterculia polyphylla* R. BR. is a juvenile stage of *St. foetida* L.; young trees often possess leaves having 10–15 narrow leaflets, mature trees have mostly 5–9-foliolate leaves with broader segments. Young *Lasia spinosa* THW. is very different from the mature plant. *Ficus basidentula* MIQ. is merely the juvenile form of *F. callosa* WILLD.; it is quite common in the hedges at Buitenzorg. The polymorphy in the habit and foliage of *Ficus quercifolia* ROXB. and *F. heterophylla* L.f. is unbelievable.

In juvenile forms of *Nepenthes* the shape of the pitchers may considerably differ from that in mature plants; as a result juvenile *Nepenthes* cannot with certainty be identified.

In *Carallia lucida* ROXB. leaves of mature trees are oblong to obovate with very shallowly serrate to entire margins; saplings, however, have oblong to lanceolate leaves distinctly serrate (4).

Other cases of old mature plants differing from young ones are found among lianas in which the shape of the stem may change considerably: *Cissus tuberculata* BL. has terete tuberculate stems but they later become flat and, in older stems, up to 60 cm broad looking like gigantic ribbons! The latter were described as a separate species, *Vitis lanceolaria* WALL., but the two forms are merely two stages of one species. The stems of lianas generally change greatly with age, through the development of corky warts and wings, together with secondary wood not present in young flowering twigs. Spines sometimes disappear in lianas and trees with age; in some cases, on the other hand, they enlarge considerably. A peculiar case is represented in two undescribed Cucurbitaceous lianas from the Lesser Sunda Islands, both having a

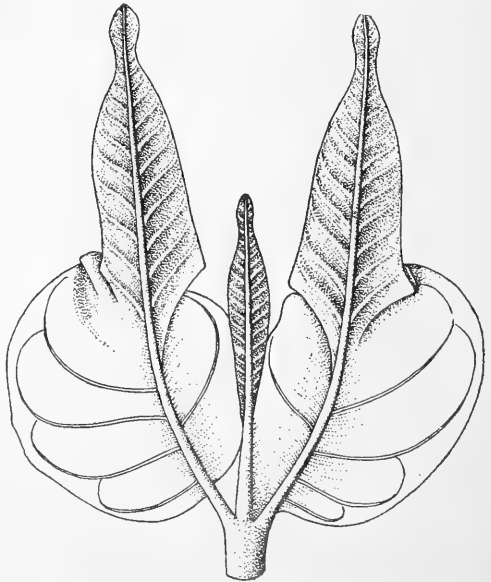


Fig. 3. Growing leaf tip of *Chisocheton* sp. (Meliac.) (bb. 23227),  $\times 3$ .



swollen base; in *Gynostemma* sp. this 'podagric' base is smooth, in *Alsomitra* sp. it is spiny (5).

Habit also sometimes changes with age: *Ancistrocladus* is sometimes a shrub in youth whereas later it becomes distinctly scandent. Climbers which have no support may sometimes grow into semi-erect shrubs; this I once observed in a plant

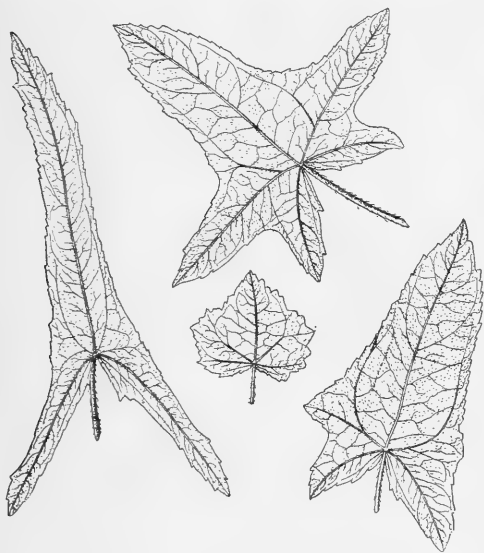


Fig. 4. *Hibiscus sagittifolius* KURZ (Malvac.), leaves from one specimen (Indramajoe, W. Java),  $\times 1/2$ .

of *Smilax modesta* DC. in a grass field on Mt Diëng.

Spotted leaves often occur only or predominantly in juvenile specimens. *Strobilanthes picta* KOORD. was a new species proposed on account of silvery spots on the leaves. However, it is a juvenile stage of *Str. cernuus* BL. Similar cases are known in *Begonia*, *Cissus*, and other genera where these spots may disappear with age. In greenhouses these juvenile forms are preferred for ornamental purposes.

Juvenile forms of plants with pinnate leaves sometimes have a much larger number of pinnae e.g. *Campsis pandorana* (ANDR.)STEEN. c.n. (6).

An example of a new species based on a juvenile plant is found in *Dacrydium*: the type specimens of *Dacrydium junghuhnianum* MIQ. from Sumatra consist of juvenile specimens of *D. elatum* WALL. with long loosely set needles.

In the herbarium flowers sometimes open during drying and create the impression of being mature. This is specially the case with flowers having valvate terete corollas e.g. *Symplocos* § *Cordylolabste*, *Styrax*, *Polyosma*, *Proteaceae*, *Loranthaceae*, &c.

MIQUEL described a new species of *Lonicera* from Sumatra *L. sumatrana* MIQ. In his description short corollas are mentioned; owing to this mistake the species was subsequently placed in the wrong section and described twice again, once from Burma

and once from Sumatra (7). The examination of MIQUEL's type specimen revealed that he described immature flowers, in fact buds which had opened in the herbarium. Immature woody capsules or strobili of *Myrtaceae*, *Theaceae*, *Coniferae*, *Casuarina*, &c. also tend to open after drying.

There is often a great similarity in the leaves of watersprouts of mature trees with those of saplings: large size, deeper incised teeth, thinner texture, e.g. in *Symplocos*, *Ficus*, *Sapotaceae*, *Dipterocarpaceae*, etc.

A still unsolved case is that of *Evonymus japonicus* THUNB. of which a sterile slender climbing and rooting form is frequently found in the Javan mountain forests. I originally took it for a juvenile shade form (8). Not until 1941 did I succeed in finding it flowering and fruiting on the open summit of Mt Jang. It is unknown whether the shade conditions in the juvenile stage determine the later morphology.

*Cited literature:* (1) A. J. KOENS, De Trop. Natuur 2 (1913) 174; see also KOORDERS, Bull. Jard. Bot. Botz. III, 1 (1919) 168. (2) Tectona 22 (1929) 1336-1340. (3) Handboek Flora Java pt 3 (1924) 109. (4) Schoolflora voor Java (1911) 486. (5) Figured in De Trop. Natuur 29 (1940) 6. (6) *Bignonia pandorana* ANDR. (7) Journ. Arnold Arbor. 27 (1946) 441, 445. (8) De Trop. Natuur 22 (1933) 175-176.

## 2. Precocious flowering (paedogenesis)

In several Malaysian plants precocious flowering is observed. COSTERUS (1) recorded flowering seedlings in *Melia arguata* DC. (fig. 5). BACKER found them in *Melia azedarach* L. and J. J. SMITH described (2) the same phenomenon in *Murraya paniculata* L. In *Cocos nucifera* L. precocious flowering is often seen. The late Dr A. RANT observed flowering seedlings in *Cinnamomum zeylanicum* THW. (oral comm.). Other plants in Malaysia in which precocious flowering has been observed are *Swietenia mahogani* JACQ., *Coffea robusta*, *Citrus decumana* L., *Nicotiana tabacum* L., *Sesbania sericea* DC., *Vigna sinensis* ENDL., *Teramnus labialis* SPRENG., *Tectona grandis* L.f., *Kalanchoe pinnata* PERS., and *Ailanthus* sp.

In plants which flower strictly periodically precocious flowering is sometimes controlled by the date of sowing. If sown too late they flower together with full-grown plants sown earlier. This is a fact well-known to agriculturists (in Java e.g. in *Hibiscus* spp.).

Precocious flowering may also be caused by poor soil or some

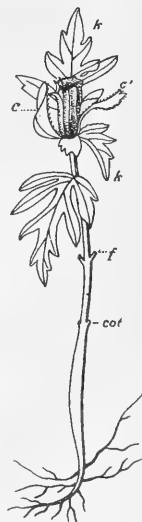


Fig. 5. Precocious flowering (paedogenesis) in *Melia arguata* DC. (Meliac.). (after COSTERUS)



methods of pruning. An example of the former cause is *Osbeckia pusilla* ZOLL. which is a flowering dwarf of *O. chinensis* L. on poor soils.

Sometimes dwarfed plants flower when very small and represent distinct varieties or strains, e.g. the dwarf of *Canangium odoratum* BAILL. f. *pumila* (3) grown in pots in Malaysia (introduced



Fig. 6. *Monophyllaea horsfieldii* R.Br. (Gesn.), adult plant, one cotyl large and leafy, the other (in front) bract-like, soon disappearing (W. Java, Kalapa Noenggal),  $\times \frac{2}{5}$ .

from China), *Aglaia odorata* LOUR. var. *microphyllina* DC., and a dwarf of *Punica granatum* L. The skill of Chinese and Japanese horticulturists in raising dwarfs is due partly to the selection of pygmy varieties but more important is their skill in impoverishing the plant without starving it (4).

Many dwarfs are found near solfatara, on rocks, and on silicious soils (cf. § 15–16).

Flowering juvenile forms are comparable to the neoteny found in the animal kingdom.

*Pteridophytes* generally are apparently more plastic with regard to precocity than *Phanerogams*,

and several species are known to form spores in dwarf or juvenile specimens which have sometimes been described as distinct species. It has been assumed that pygmy species in *Antrophyum* may possibly represent neoteny stages of other species. COPELAND described in 1939 (5) a dwarf fern from Borneo as *Holttumia*, but it is Dr DONK's contention that this fern is a precocious stage of a *Taenites*. In the genera *Teratophyllum*, *Stenochlaena* and *Lomariopsis*, HOLTUM (6) was able to demonstrate that a great deal of confusion is caused by the description of juvenile stages; being familiar with the living plants in the field he clarified the true status and affinities of a number of obscure species.

DIELS (7) compiled an instructive book on juvenile forms, giving instances where the juvenile foliage persists in the mature flowering plant, a course of development comparable to neoteny forms in zoology. Australian and New Zealand botanists have written a great deal about this phenomenon of heteroblasty which in those floras has apparently an important bearing on speciation (8). I cannot remember a Malaysian plant suspected to represent such a case. Yet such strange plants as *Monophyllaea* (fig. 6) and allied genera of the *Gesneraceae* living on the enlarged cotyledons might be examples.

*Cited literature:* (1) Rec. Trav. Bot. Néerl. 1 (1904) 128. (2) De Trop. Natuur 1936, Jub. uitg. p. 73. (3) Now described as a separate species *Canangium fruticosum* CRAIB (Kew Bull. 1922, p. 166) being cultivated in Siam. (4) Compare F. A. McCLURE, in Lingn. Sci. Journ. 12 (1933) Suppl. p. 119–149. (5) Philip. Journ. Sci. 74 (1941) 153–156. (6) Gard. Bull. Str. Settlement. 5 (1932) 245 seq.; *ibid.* 9 (1937) 139 seq. (7) Jugendformen und Blütenreife im Pflanzenreich 1905. (8) cf. COCKAYNE, 13th Meeting Australas. Ass. Adv. Sci. (1912) 217 seq.

### 3. *Dimorphous foliage*

It was observed by F. W. WENT (1) that in trees generally the foliage of the lower branches is larger than that of the upper twigs. He ascribes this to the amount of water available to different shoots (internal water-conducting capacity); so, in mature trees the upper foliage would be insufficiently provided with water. The leaves of water sprouts, on the other hand, are mostly exceedingly large as their water supply is abundant. Leaves of these shoots are mostly hardly recognizable in the herbarium, as they may reach disproportionate dimensions. Foliage for description in the herbarium ought therefore to be comparable and preferably that of flowering twigs.

The dimorphy of the foliage is mostly linked up with a difference between flowering and non-flowering parts of the plant, similar to that found in *Hedera*. It is conspicuous in several climbing *Ficus*, *Piper*, *Araceae*, and in some *Conifers*. A striking example of plagiotropically flowering twigs is that of *Abroma angusta* L.f.

A good illustration is also *Luvunga sarmentosa* (BL.) KURZ (*Rutaceae*). The stem shoots of this

liana possess large straight axillary thorns and 1-foliolate leaves. The climbing shoots, however, possess conspicuously curved thorns and 3-foliolate leaves and the flowering parts of these are often unarmed. *L. eleutherandra* DALZ. was based on a type different from BLUME's but is actually the same species, as was found by KURZ (2).



Fig. 7. Heterophylly in *Ficus deltoidea* JACK (= *F. diversifolia* BL.) (Morac.), Mt Gedeh, W. Java,  $\times 2/3$ .

Putting into practice what he had read of *Hedera helix* in a botanical manual, Mr BOLT made a remarkable application of the dimorphy of *Piper cubeba* L. Near Semarang, instead of cultivating it as a climber he took cuttings of the flowering twigs, and got shrublets which, though small, produced abundantly 'tail pepper'.

Plants with dimorphous foliage are very numerous in Malaysia and species are frequently named after this peculiarity. *Ficus deltoidea* JACK (= *Ficus diversifolia* BL., fig. 7) is one of them; L. VAN DER PIJL (3) could not find any regularity in its heterophylly. In *Faradaya dimorpha* PULLE from New Guinea there are two kinds of twigs, with decussate and with 3-whorled leaves of different shape. *Phytocrene macrophylla* BL. has both entire and 3-lobed leaves on one individual, as have *Broussonetia sumatrana* MIQ., *Knema heterophylla* WARB., several species of *Gmelina* and *Sterculiaceae*, *Tiliaceae*, *Artocarpus varians* MIQ. A good case is also *Urvia picta* DESV. (fig. 8). Heterophylly is common in ferns.

Polymorphy in leaf shape among different individuals of a population is a subject which ought to have a separate heading. It is of universal occurrence in the Malaysian flora, and has (e.g. in *Cucurbitaceae*) given rise to a multiplication of names. In *Coccinea*, MIQUEL (4) distinguished two species, one with incised leaves and one with angular entire leaves: according to BACKER they are identical, the incised leaves mostly belong to juve-

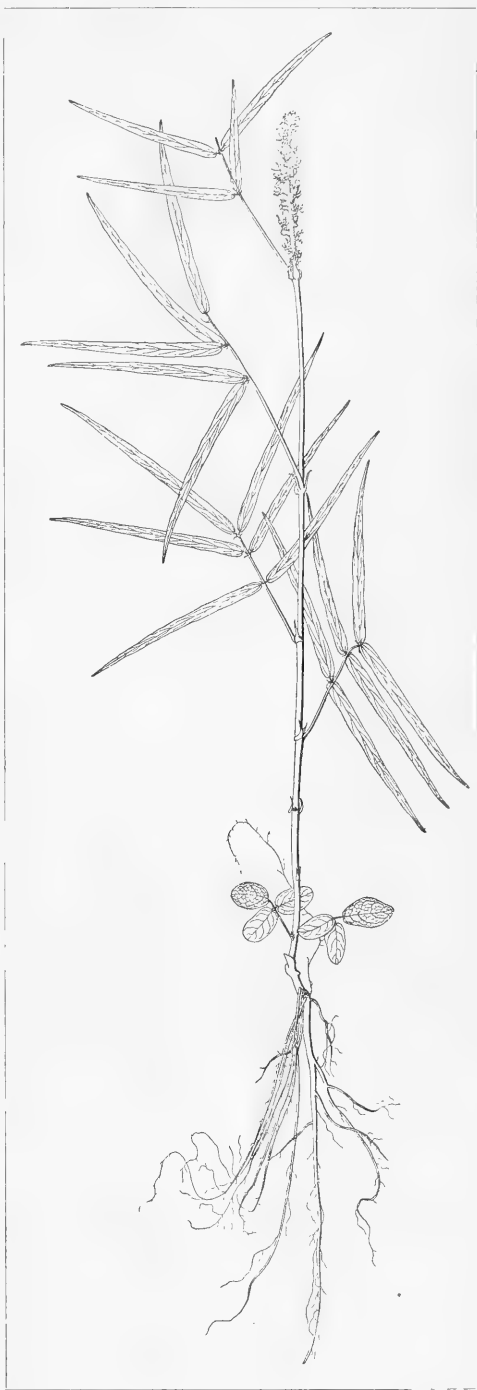


Fig. 8. *Urvia picta* DESV. (Legum.), with heterophyllous foliage, Kangean Island, moist *Imperata* fields at low alt.,  $\times 1/2$ .

nile specimens. In *Gymnopetalum cochinchinense* (LOUR.) KURZ there is even more confusion: specimens with incised leaves have been described as *G. septemlobum* MIQ., *G. quinquelobum* MIQ. and *G. quinquelobatum* COGN., those with angular or entire leaves as *G. piperifolia* MIQ. and *G. horsfieldii* MIQ. There is probably a host of other names



Fig. 9. Macrobiocarp in *Callistemon speciosus* DC. (Myrt.) with 3 sets of fruits below the terminal bud, originating from 3 previous flowering periods,  $\times 1/4$ .

for this species which is very variable in foliage. In *Trichosanthes* a similar polymorphy of the foliage caused superfluous description of species. *Tr. grandiflora* BL. is, according to BACKER, a form of *Tr. globosa* BL. with lobed leaves. In *Gynostemma* CLARKE and BACKER assume a variability in foliage (3-foliolate to pedately lobed leaves) which will cause a considerable reduction of the number of species. Similarly scores of superfluous names are found in polymorphic species such as *Urena lobata*

L. etc. In the *Oleaceae*, *Nyctanthes dentata* BL. is only a dentate-leaved form of *N. arbor-tristis* L.

In some Pteridophytes heterophyllous leaves are well known. The most striking examples occur in the genera *Teratophyllum*, *Stenochlaena* and *Lomariopsis* where according to HOLTUM (5) heterophylly has caused much taxonomic confusion. An other striking case is that of the plant which is mostly cited as *Lindsaya repens* (BORY) BEDD. as demonstrated by W. TROLL (6).

Cited literature: (1) Handel. 5e Ned. Ind. Nat. Wet. Congres (1928) 385-392 (1929). (2) Journ. As. Soc. Beng. 39 (1870) 69. (3) De Trop. Natuur 27 (1938) 89. (4) Flora Ind. Bataviae 1, 1 (1855) 673. (5) Gard. Bull. Str. Settlem. 5 (1932) 245; *ibid.* 9 (1937) 139. (6) Flora 126 (1932) 408.

#### 4. Dimorphous seeds and fruits

Of *heterocarp* (1) only few examples are known in the Malaysian flora. In some *Compositae* the marginal fruits are sometimes strikingly different from those produced by the central tubular flowers, as was described for *Synedrella nodiflora* GAERTN. by A. ERNST (2). It is also known that in *Tragia volubilis* L. normal and 2-hooked one-seeded fruits may occur together.

In *Umbelliferae* normal fruits and fruits with one half reduced may sometimes be observed.

In *Leguminosae* also different types of fruit are sometimes found on one plant. In *Desmodium heterocarpum* DC. the lower pods are 1-seeded, the upper 5-7-seeded.

Dimorphous fruits and seeds are known in *Aeschynomene* spp. and in the genus *Jussieua*.

One of the most curious cases of dimorphous fruits is that detected by BACKER (3) in the common *Acalypha indica* L. in Java where the tip of the male spikelets is crowned by a single female flower developing into a T-shaped fruit with a central fertile and 2 lateral sterile cells; the central cell seems to be sunken in the tip of the axis of the rachis. The normal capsule consists of 3 equal cocci.

A special case is that of *macrobiocarp* (4) when not all fruits dehisce at the end of the season but a number remain closed on the plant and grow for years larger and woody. Sometimes fruits of 3-4 seasons are found on one twig, which thus keeps a reserve of seeds. Macrobiocarp seems to be mainly restricted to the semi-arid climates and is of definite advantage in fire-swept areas. It is very common in some genera of capsular *Myrtaceae* (fig. 9), viz *Leptospermum*, *Eucalyptus*, *Melaleuca*, *Agonis*, *Metrosideros*, *Syncarpia*. It possibly also occurs in some *Proteaceae*, *Coniferae*, *Casuarina*, and some *Rubiaceae*.

The woody structure, large size and modified shape of the fruits formed in previous seasons must be allowed for in identifying the species. Inadequate material may cause considerable confusion.

Cited literature: (1) DELPINO, Mem. R. Ac. Sc. Inst. Bologna V, 4 (1894). (2) Ber. Deutsch. Bot. Ges. 24 (1906) 450-459. (3) Onkruidflora Jav. Suiker. (1930) 406-407. (4) WINKLER, Ann. Jard. Bot. Btzg 20 (1905) 37-41.

5. *Dimorphous flowers*

A most peculiar case of flower dimorphism occurs in some *Orchidaceae* viz in *Renanthera lowii* RCHB. f. (1) and *Grammatophyllum speciosum* BL. (2). The shape and colour of the lower flowers in a raceme are very much different from those of the upper ones. In these Orchids the occurrence of aberrant lower flowers is a normal phenomenon. It seems also to occur in some species of *Arachnis* and less obviously in some species of *Bulbophyllum*.

In *Oberonia imbricata* LINDL. the upper flowers of the spike are abnormal and their gynaecium is reduced.

Dimorphic flowers are also frequently found in dioecious and polygamous plants. Male and female flowers are sometimes very different in shape and size, e.g. in *Mangifera*, *Brucea*, *Hevea*, &c.

In thyrsoid inflorescences the marginal flowers are often different from the central ones, or sometimes the central ones are reduced or deformed. A conspicuous instance is *Mussaenda* where some flowers of the inflorescences have one calyx lobe large and leafy. Other cases are found in *Hydrangea*, *Sambucus javanica* REINW., some *Umbelliferae*, some *Araliaceae*, e.g. *Boerlagiodendron*, and some *Mimosaceae*.

*Cited literature:* (1) WINKLER, Ann. Jard. Bot. Btzg 20 (1906) 1. (2) COSTERUS, Dodonaea 6 (1894) 24.

6. *Cleistogamous flowers*

Cleistogamous flowers occur frequently in the Malaysian flora. A general survey has hitherto not been compiled.

They were described in *Clitoria* by HARMS (1) and RANT (2) where they are sometimes more frequent than normal flowers. The description of specimens with cleistogamous flowers has led here to phyto-graphical confusion: the American genus *Martia* LEAND. SACR. was based on a cleistogamous leguminous plant which is, actually, according to BENTHAM and HARMS (*l.c.*) nothing but the cleistogamous state of *Clitoria*.

Cleistogamy also occurs in Malaysian species of *Viola*. It is stated by BECCARI (3) to occur in several Bornean *Annonaceae*.

A very typical example is described in *Commelina benghalensis* L. by J. VAN WELSEM (4): cleistogamous flowers are present on subterranean shoots.

Another well known case in a common plant is *Ruellia tuberosa* L. mentioned by VAN WELSEM (5) and A. F. G. KERR (6).

Cleistogamous (better: *cleistopetalous*) flowers are common in *Orchidaceae* as J. J. SMITH and R. SCHLECHTER both frequently mentioned. The former gives a list of cases known to him in connection with his experience on autogamy (8); the latter studied the occurrence of cleistogamy especially in New Guinea (7) and found it in several genera, and both in the lowland and in the mountains. Sometimes in several specimens all the flowers are cleistogamous, e.g. in *Eria rugosa* LINDL. and *Dendro-*

*bium gemellum* LINDL. SMITH even found species which are only known in the cleistogamous state (8, p. 138), or of which normal flowers have only occasionally been found.

SMITH suggests that cleistogamy is more common in the rainy season, and he mentions that R. SCHLECHTER also got the impression that cleistogamy was common in very wet places in Sumatra and in the mossy forests of New Guinea more frequent in the rainy season than in the dry period. The same phenomenon has been observed by C. A. BACKER (9) for cleistogamy in *Didipliptera canescens* NEES (*Acanth.*) in Java; in moist countries or during wet periods in the dry season this plant produces minute white cleistogamous flowers the corollas of which drop in the early morning.

It is certainly noteworthy that a single trivial character like cleistogamy can so upset taxonomical judgment that a new genus has been based on this abnormal state of a plant; this character changes the whole floral development, and suppresses the manifestation of numerous genomic tendencies in the mature plant. Physiologically this can only be explained by some break in the physiological chain reactions in an early stage of the development of the flower. The field observations mentioned above may show how this problem may be studied experimentally.

*Cited literature:* (1) Ber. Deutsch. Bot. Ges. 25 (1907) 165–176. (2) Ann. Jard. Bot. Btzg 44 (1935) 239–242; Bull. Jard. Bot. Btzg III, 4 (1922) 241. (3) Wanderings in the great forests of Borneo (1904) 402. (4) De Trop. Natuur 4 (1915) 142; see also BACKER, Handb. Flora Java pt 3 (1924) 25. (5) De Trop. Natuur 2 (1913) 53–58, 68. (6) Journ. Siam Soc. Nat. Hist. Suppl. 10 (1935) 66–67. (7) Die Orchid. Deutsch Neu Guinea, FEDDE, Repert. Beih. 1 (1914) p. 1–li. (8) Natuurk. Tijdschr. Ned. Ind. 88 (1928) 122–140, Orch. Rev. 37 (1929) 75, Nova Guinea 14 (1929) 359. (9) Onkruidflora Jav. Suiker (1931) 676, *in nota*.

## Teratologo-morphosis

7. *Teratological forms*

Malaysia can boast of a series of good articles by J. J. SMITH & J. C. COSTERUS (1) dealing with teratological phenomena in plants.

Though several of these teratological forms are due to some hereditary factor, others are apparently caused by external factors. Some are possibly the result of a fungus's attack though no fungus has been found.

*Pometia pinnata* FORST. almost always has peculiar large brown structures like witches' brooms by which the tree can easily be recognized in the riverine forest: they suggest inflorescences.

*Invirescentia* are quite a common phenomenon in several *Compositae* (fig. 10); the fact that they are often found together in colonies in several different species suggests that they may be due to some virus (?).

*Monstrous flowers* occur rather frequently in *Orchidaceae* and have often confused systematists.

J. J. SMITH (2) has given an interesting account of them. The absence of a rostellum is closely connected with autogamy. As a result the flowers often hardly open, do not develop well, and their colour is paler than normal e.g. in *Phajus tankervilleae* Bl.

forms are treated in more detail in the following chapter, paragraph 2.

Teratological aberrations frequently cause such large changes in the structure of flowers that they strongly suggest some taxonomic novelty. An additional example is: an interesting 3-seeded *cocunut* (3). DE WIT & POSTHUMUS collected at Buitenzorg, Sept. 1944, a specimen of *Cassia mimosoides* L. of which each flower possessed 2 ovaries. This character is considered to be primitive or ancient in the *Leguminosae*; it has been reported to occur in several *Caesalpiniaceae*, e.g. in African *Schwartzia* (6) and Indian *Caesalpinia* (7). In *Archidendron*, a genus of *Mimosaceae* centred in New Guinea, it is a generic character.

Monstrous forms occur frequently in *ferns* where the plasticity seems greater than in *Spermatophyta*. Forked, lobed, and crisped leaves occur in many genera. Sometimes these monstrosities seem to be inherited and of racial rank (4). Even precocious spore formation may be partly inherited.

Teratological aberrations merge gradually into *individual variations*. It is questionable whether an individual of *Cassia mimosoides* L. with two ovaries is to be classed as a teratological or individual variation.

I will mention only a few examples of individual variation. MELCHIOR found (5) some flowers in *Aphania masakapu* MELCH. with free anthers. BACKER found individuals of *Alysicarpus rugosus* DC. with 2-3-foliolate leaves. The leaves of *Cissampelos pareira* L. are sometimes both peltate and non-peltate in one plant. Some specimens of *Amaranthus spinosus* L. are unarmed.

There is no end to this kind of individual variation which sometimes affects typically structural characters. Experiments are needed to ascertain whether these aberrant plants are sports of the genom and hereditary or not.

*Cited literature:* (1) Ann. Jard. Bot. Btzg vols 13, 19, 23, 24, 28, 29, 32, 33, 39, 42 (1895-1931). (2) Natuurk. Tijdschr. Ned. Ind. 88 (1928) 122-140. (3) Natuurwet. Tijdschr. Ned. Ind. 101 (1941) 144. (4) O. POSTHUMUS, De Trop. Natuur 25 (1936) 177-178. (5) Notizbl. Berl.-Dahl. 10 (1928) 277. (6) JACQUES-FÉLIX, Bull. Soc. Bot. Fr. 92 (1945) 158. (7) WIGHT & ARNOTT, Prod. Fl. Pen. Ind. Or. (1834) 281.

### Hypselo-morphosis

#### 8. Phenotypic effect of altitude

G. BONNIER, and later F. E. CLEMENTS, experimented on the effect of altitude on plants. BONNIER even assumed that species might change under prolonged exposure to different conditions into other species but it seems that his experiments are untrustworthy (1).

In the Malaysian mountains where collectors are often compelled to follow ridges, plants from exposed situations are frequently brought home. Their foliage is often reduced, the leaves roundish, margins recurved, texture coriaceous, venation prominent, petioles reduced, habit compact. It is

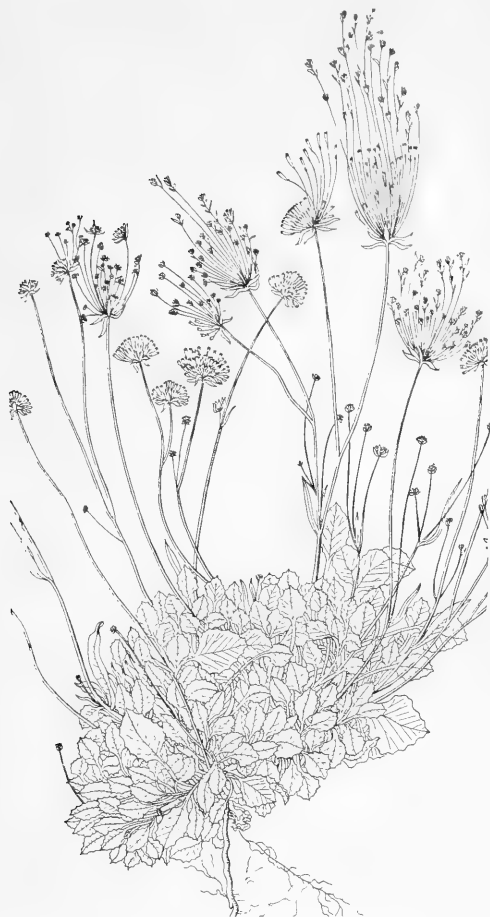


Fig. 10. Invirescence of *Emilia sonchifolia* DC. (Comp.) from Mt Abang, Bali, sandy riverbed, ca 1000 m,  $\times \frac{1}{2}$ .

Sumatran specimens are apparently more normal than Javan. Of quite a number of these abnormal *Orchidaceae* no normal specimen is as yet known.

Another abnormality is a variation in the number of anthers, which, in *Dilochia pentandra* RCHB. f., is five; this 'species' is, however, a mere form of *D. wallichii* LINDL. In other cases the third stigmatic lobe is changed into a rostellum and the rostellum has become a stigmatic lobe.

J. J. SMITH remarks that the phenomenon of peloria occurs in different degrees. Mostly the peculiarities of the labellum disappear, sometimes the tepals show some characteristics of the labellum. As peloria is for the most part inherited these

not always certain that these characters are a 'normal feature' of the species. It is, therefore, of the greatest importance to try to collect such species from less exposed habitats (light, wind, poor soil), *i.e.* from the more fertile, sheltered, though less

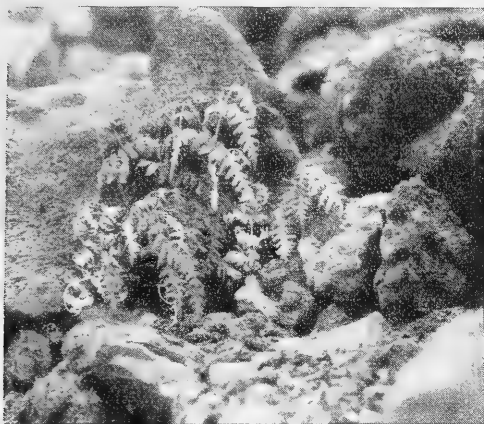


Fig. 12. *Histiopteris alte-alpina* v. A. v. R. (*Polypod.*), an altitudinal form of *H. incisa* J.Sm., in its habitat between 'sterile' rocks on the summit of Mt Kerintji, W. Sumatra, ca 3750 m alt. (FREY WIJSSLING)

accessible slopes. Extensive notes and large collections may show that such variability exists and serve to define the position of transitional specimens. The same species may be a crooked gnarled shrub when growing on a ridge and a moderately tall tree 50 m lower on the slope.

The dwarfing of trees towards the summits of mountains and ridges is chiefly due to the gradual disappearance of the bole with increasing altitude. This is partly a consequence of the development of the young plants under a gradually increasing light intensity which stimulates branching close to the base. I observed a striking example in the field of dwarfing in *Casuarina junghuhniana* Miq. on Mt Soeket, Idjen volcano, E. Java. Herbs too are generally dwarfed at high altitude, *e.g.* *Erigeron linifolius* WILLD.

I studied an instructive case of variation induced by altitude combined with poor rocky soil in the grass *Isachne pangerangensis* Z.M. (fig. 11). A large series of transitions from tall to dwarfed specimens were represented.

An example of a 'hypselo-morphosis' which has been described as a local-endemic species is that of the fern *Histiopteris alte-alpina* v. A. v. R. (fig. 12) from the summit of Mt Kerintji, West-Central Sumatra, which is found at ca 3700 m alt., on a barren rocky ridge. This is certainly only a form of the common volcanophile *H. incisa* J. Sm.

It is difficult, however, to single out the various factors associated with increasing altitude *viz* more wind, sudden and large changes of temperature, strong insolation, poorer soils, lower atmospheric



Fig. 11. Variable habit of *Isachne pangerangensis* Z.M. (Gram.) in N. Sumatra, Mt Losir, *a.* on burnt ridge in thick humus, 1500 m, *c.* on ridge with ericoid scrub, half-shade, thinner soil, 2000 m, *d-e.* open sandy flats on poor soil, 3000 m, *f.* on rocky windswept summit, soil nearly absent, 3440 m,  $\times 1/4$ .

pressure, different fluctuations of atmospheric humidity, greater difference between day and night temperatures, &c. In the absence of experiments one can only make some suggestion, in many cases based on observation in the field only.

I know of only few species which are hairier in the mountains than in the lowland, e.g. *Hydrocotyle sibthorpioides* LAMK, of which BLUME described the hairy form as *H. hirsuta* BL. *non al.* However, glabrous forms of this species also occur on the mountains! An other example is that of *Dodonaea viscosa* (L.) JACQ.

KURZ (2) in his 'Sketch of the Vegetation of the Nicobar Islands' has remarked on the apparent absence of any general relation between hairiness and environment.

There is no general rule that flowers are brighter coloured in the mountains. *Ageratum houstonianum* MILL. has larger capitules and brighter blue flowers in the mountains than at low altitude but on Mt Pakiawang, S. Sumatra, I found the reverse (3), *Scutellaria javanica* JUNGH. var. *sumatrana* BACKER having here blue flowers at the base of the peak but white ones towards the summit.

Of *Dendrobium jacobsonii* J. J. S. (§ *Pedilonum*) from the *Casuarina* forests 2400–2900 m alt. in East Java, J. J. SMITH says that at Bandoeng at 700 m alt. cultivated specimens had smaller and paler coloured flowers with a slightly different flower shape: mentum not bent and differences in the labellum; the inflorescences were, moreover, sometimes 2-flowered (4).

Fruiting and flowering are also strongly influenced by altitude, as I demonstrated elsewhere (5).

Experiments on the influence of altitude, the morphological and physiological behaviour of Malaysian plants have been scarcely made. TEYSMANN made some observations in his pioneer work on Mt Gedeh in West Java but did not comment; COSTER (6) wrote a note on the beech specimen planted by the former.

In the Malay Peninsula RIDLEY (7) made some notes on the acclimatization of plants and the ways in which they can be accommodated at low altitude.

*Cited literature:* (1) The New Systematics 1940, p. 55 *seq.* (2) Journ. Asiat. Soc. Beng. new ser. pt II, 45 (1876) 126. (3) Bull. Jard. Bot. Btzig III, 13 (1933) 16. (4) Bull. Jard. Bot. Btzig II, no 26 (1918) 41. (5) Bull. Jard. Bot. Btzig III, 13 (1935) 331–343. (6) Ann. Jard. Bot. Btzig 35 (1926) 105. (7) Agric. Bull. Str. & Fed. Mal. St. volumes 6–7 (1907–08).

## Photo-morphosis

### 9. Epiphytes

It is sometimes wrongly assumed that epiphytism is confined to specific plants which are restricted to this mode of life. The amount of light appears to be the main factor. On the floor of closed forest the shade prevents epiphytes from making use of patches of bare soil, which in primary forest are always present. Exposed places, such as rocks, lava streams, landslides, poor silicious soils, mud

streams and solfatara, however, offer conditions suitable for their growth, and are indeed often the places where many epiphytes are assembled, *i.e.* selected from the neighbouring forest. Though epiphytes may withstand dry conditions well, they mostly need a rather high atmospheric humidity which, in these exposed places, becomes a limiting factor. Most astonishingly rich communities of epiphytes I found on the often misty slopes of Mt Têlong in N. Sumatra which from 1800 m upwards is like a rock garden carpeted with normally epiphytic orchids amidst luxuriant dripping cushions of hepatics and mosses with some isolated dwarf *Rhododendrons*. It is sometimes contended that these terrestrial epiphytes are *epilithes* but I have



Fig. 13. *Vaccinium laurifolium* MIQ. (*Eric.*) as a hemi-epiphyte, height ca 5 m, along a road above Trêtès, 1500 m, N. slope of Mt Ardjoeno, E. Java.

also found them in deep humic soil between the rocks. I did not succeed in detecting any essential differences in habit between terrestrial and epiphytic specimens.

In other species, though, the terrestrial speci-



Fig. 14. Habitat variations of *Gentiana quadrifaria* BL. (*Gent.*) in Java. The condensed pin-cushion shape is found on open dry windswept habitats, the loose habit on marshy or slightly shady soil,  $\times \frac{1}{2}$ .

mens may differ considerably in habit from epiphytic; they become more rigid and condensed, often fastigate. *Vaccinium lucidum* (BL.) MIQ., as an epiphyte is a loosely and irregularly branched shrublet with a tuberous woody base. Terrestrial specimens on ridges are mostly cupressus-shaped miniature trees without the woody tuberous base. Similar differences are found in *Ficus deltoidea* JACK of which the epiphytic and terrestrial specimens may differ considerably in habit.

It goes without saying that a proposal by NAKAI (2) to distinguish the Ericaceous *Agapetes* and *Vaccinium* by a terrestrial habit in the latter and an epiphytic habit in the former did not meet with the approval of SLEUMER.

Some species begin their life as epiphytes but, when their roots subsequently reach the soil, they may grow into trees and sometimes show no sign of their early history. Such is found e.g. in *Ficus*, *Fagraea*, *Schefflera*, *Wightia* (1), and I even found it once in *Vaccinium laurifolium* MIQ. (fig. 13). Many, however, are equally able to germinate terrestrially and grow normally to trees. This is, in *Wightia*, even more common than the hemi-epiphytic habit. As a small tree it is gregarious on the unbaked lava streams of Mt Idjen in East Java, but on the forested outer slopes of the same mountain it is a hemi-epiphyte.

*Cited literature:* (1) Revision of *Wightia*, Bull. Jard. Bot. Botz III, 18 (1948) in the press. (2) Japan. Journ. Bot. 12 (1936) 37-38.

#### 10. Shade forms

Shade forms are found both in the lowland and the mountains. In general they possess larger, thinner leaves, longer internodes, &c. Shade and normal leaves may occur in one individual. A very good example is *Gentiana laxicaulis* Z.M. described from Java, which appears to be a shade form of *G. quadrifaria* BL. Sometimes compact tussocks of the latter bear on one side shoots of 'laxicaulis' in one individual plant (fig. 14).

*Slender modifications* of herbs can be observed in tall grass fields, comparable with those in temperate corn fields. These weeds growing in the damp dark micro-climate between the closely set culms of *Saccharum spontaneum* L., *Andropogon amboinicus* (L.) MERR., etc. strive for light. They show reduced leaves and inflorescences in relation to their lank habit. All herbs unable to emerge from the tops of the grasses show a similar habit, a kind of etiolated growth combined with some degree of nanism.

For the effect of light on the habit of forest trees see the paragraph on savannah trees.

#### Hygro-morphosis

##### 11. Influence of drought

Hardly anything is known of the influence of drought, and the changes induced by it in the morphology and physiology of Malaysian plants. In *Gerbera jamesonii* BOLUS I observed in the dry year 1945 at Buitenzorg an astonishing reduction in length of the peduncles in relation to leaf length. The size of the leaves was very much reduced during the same period in *Turnera subulata* SM. (*T. trioniflora* AIT.).

Similar behaviour is mentioned by BACKER (1) in *Jatropha gossypifolia* L. var. *elegans* M.A., a plant which is thoroughly naturalized in the dry regions of Java and the Lesser Sunda Islands; during the driest period of the dry season only minute, short-petiolate dark-brown leaves are produced.

Flowering of some trees, e.g. *Dipterocarpaceae*, and probably *bamboos* coincides with unusually dry years. Higher fungi fructify after a dry spell.

*Cited literature:* (1) Onkruidflora Jav. Suiker. (1930) 411.

#### Hora-morphosis

##### 12. Seasonal variation

Seasonal variation as described in Europe (1) I have not found recorded from Malaysia. In the cultivated *Hibiscus sabdariffa* L. I have seen fruiting specimens flowering a second time; these flowers, however, were only half the normal size and, also, paler in colour. Field botanists should search for 'autumn forms' in periodically dry regions.



Seeds of seasonal plants germinating in the wrong season may sometimes grow into dwarfs. I observed such forms also in *Hibiscus sabdariffa* L. at Buitenzorg. These dwarfs were 10–15 cm high and



Fig. 15. Oblique, wind-trimmed *Tamarindus indica* L. (Leg.) on a ridge at ca 600 m on Noesa Penida, SE of Bali Island (DE VOOGD)

had 2-3 flowers producing good seeds; the flowers were mostly much smaller than those of specimens flowering in the optimal season.

Of leaf-shedding trees flowers are often collected with immature foliage which may deviate considerably from mature leaves. A peculiar case is that



Fig. 16. Compact dwarfing of plants near the fumaroles on the summit of Mt Kembar, Ardjoeno, E. Java, 3100 m alt. Normal specimens left, dwarfed ones right,  $\times 1/3$ .

of some leguminous trees which produce leaves in flushes; the latter consist of pale or white or even pink-coloured limply hanging leaves which only slowly get their normal texture (*Maniltoa*).

The distinction between annuals, biennials and perennials causes many difficulties in species growing both inside and outside the tropics, specially when the duration of life is used as a character to establish taxonomic limits. I assume e.g. *Centrolepis* to be annual in N. Sumatra, though its perennality in S. temperate regions is used as a distinctive generic character against allied genera. In some *Gramineae* species may be similarly variable, specially in tropical localities, and thus deviate from temperate representatives of the same species in a character which is, in grasses, generally assumed to be of importance for the delimitation of species if it runs parallel with other morphological differential characters. It is puzzling me how it is possible to interpret from herbarium specimens the duration of life of perennials flowering during their first year and collected in that state. The use of the duration of life as a character in keying out species must be limited to very clear cases based on wide experience.

*Cited literature:* (1) R. v. WETTSTEIN, Unt. ü. d. Saison-Dimorphismus im Pflanzenreiche. Wien 1900. 42 pp.

### Anemo-morphosis

#### 13. Windforms

A peculiar aberrant habit in shrubs and trees can be caused by constant winds. I have described this from Noesa Penida and Bali (1) in *Terminalia catappa* L., *Barringtonia asiatica* (L.) KURZ, *Calophyllum inophyllum* L., *Bischofia javanica* BL., *Ficus* sp., and *Tamarindus indica* L. (fig. 15). Other more recent examples are *Dodonaea viscosa* JACQ. near the Wijnkoops Bay, S. Java, and plants from Padang Bolak in N. Sumatra described by M. VAN DER VOORT (2). These plants possess sometimes a peculiar oblique condensed one-sided habit and always show a decreased leaf size apparently owing to desiccation of the buds. They are found both on seashores and inland.

*Cited literature:* (1) De Trop. Natuur 26 (1937) 69–78, 14 fig. (2) De Trop. Natuur 28 (1939) 201–209.

### Edapho-morphosis

#### 14. Fumarole plants

I have described (1) very aberrant modifications from some mountain summits viz Mt Ardjoeno in East Java (2) and Mt Agoeng in Bali (3) at 2900–3000 m alt. Some common lowland weeds, have through chance dispersal by wandering pilgrims and/or by deer established themselves in the immediate neighbourhood of fumaroles. Owing to the heat and moisture emitted by the fumaroles they are able to grow at these high altitudes. They are very much reduced in size and in habit very condensed, and their leaves are very small (fig. 16). Without

flowers their identification would be difficult. They live in what may be called 'open air hothouses' in the subalpine zone, and the altitude, insolation, &c. are doubtless the factors which have induced their



Fig. 17. Dwarf of *Pemphis acidula* FORST. (Lythr.) in flower and fruit, seashore of Oedjoeng Koelon, W. Java,  $\times 2/5$ .

aberrant mode of growth and resulted in what seems to be an 'alpine habit'.

The species concerned were: *Hyptis brevipes* POIR., *Dichrocephala chrysanthemifolia* (BL.) DC., *Lycopodium cernuum* L., *Emilia sonchifolia* DC., *Bidens pilosus* L., *Oldenlandia herbacea* ROXB., *Fimbristylis capillaris* A. GRAY, *Lindernia crustacea* F. v. M.



Fig. 18. Full-grown specimen of *Pemphis acidula* FORST., NE. coast of P. Tioman, Mal. Peninsula. (CORNER)

*Cited literature:* (1) The Gard. Bull. Str. Settlement. 9 (1935) 63-69. (2) De Trop. Natuur 23 (1934) 119-120. (3) De Trop. Natuur 25 (1936) 158-159.

#### 15. Rock plants; calcareous and silicious soils

Both rocks and silicious soils may bring about rather conspicuous changes of habit in some plants, apparently owing to the small amount of nutrients available. These modifications can occur either at low or high altitude.



Fig. 19. Flowering and fruiting dwarf of *Leptospermum flavescens* J.Sm. (Myrt.) on dry sterile sands of Toba highlands, Central Sumatra, in a heath-like vegetation,  $\times 1/2$ .

Mr C. N. A. DE VOOGD collected dwarf specimens of *Pemphis acidula* FORST. (fig. 17) on the rocky coast of SW. Java resembling subalpine 'Spaliersträucher'; normally this littoral species is a bush or small tree (fig. 18).

On the so-called 'padangs', the gravelly or sandy flats of various geological history which sometimes occupy large areas in Sumatra and Borneo, many species are dwarfed: *Leptospermum flavescens* SM. when growing under optimal conditions is a medium sized cedar-like tree (fig. 20); here it is a dwarf, 10-20 cm high, which flowers and fruits abundantly (fig. 19). Many other species behave similarly. If herbarium specimens are not provided with good field notes, a botanist who has never visited the tropics is of course confronted with a puzzle. He may even find some other slight charac-

ter not known to occur in the normal population and may think that they represent a different species: in this way another 'paper species' is created. Residents in the tropics ought to experiment with seeds gathered from dwarf individuals. Abandoned mining grounds in Banka, Billiton and Borneo are rich in dwarf forms of the most diverse species, which flower precociously as very small individuals (1).

flowers, an unusual character in the species (2). Though no experiments have been made it is likely to be an edaphical form only.

Scores of dwarfed species, mostly of shrubs or small trees but also of herbs (e.g. *Dianella nemorosa* LAMK. f. *nana* SCHLITTL. from Camarines and f. *monophylla* SCHLITTL. from New Guinea) occur in the Philippine Islands, and especially in New Guinea on ridges in the mossy forest and the sub-



Fig. 20. Full-grown specimens of *Leptospermum flavescens* J.SM. (Myrt.) on the slopes of Mt Bonthain, SW. Celebes. (L. VAN DER PIJL)

On poor unweathered volcanic ash on the slopes of mountains the vegetation as a whole is dwarfed, e.g. on the slopes of the easily accessible Mt Lamongan, E. Java. Here the black gravel and sand is continually rejuvenated and gradually runs down. On these ash slopes all the common Javan mid-mountain trees and shrubs are dwarfed but flower and fruit profusely e.g. *Radermachera gigantea* (BL.) MIQ., *Parasponia parviflora* MIQ., and *Weinmannia blumei* (BL.) PLANCH., &c. flower and fruit on 1–2 m high shrubs. This observation induces me to suspect that *Radermachera brachybotrys* MERR. from Leyte merely represents a dwarf specimen of some other species; KORTHALS found a similar specimen in the padangs of Borneo.

I have also found dwarfs on wooded limestone cliffs in NW. Bali at 100–200 m mostly of herbaceous species. One of them was so aberrant that I described it as a new variety, *Anisomeles indica* (L.) O.K. var. *biflora* STEEN.; this had solitary

alpine zone. No experiments have been done and the 'normal' habit of these plants is thus unknown.

On rock cones, e.g. Mt Idjen, E. Java (fig. 21) and Mt Agoeng, Bali, I found *Casuarina* (fig. 22), *Vaccinium*, *Rhododendron* as extremely small shrubs and ascribed this to the very poor soil, though on these cones the influence of climate and soil are not readily separable.

W. TROLL found precocious spore formation in *Gleichenia vulcanica* BL. on Mt Gedeh. This was certainly not caused by altitude but by the locally poor rocky soil. In cracks of rock on the summit Argapoera, of Mt Jang, E. Java, I have collected microphyllous specimens of a *Polygonum* which I originally took for *P. chinense* L. but which DANSER afterwards identified as an aberrant form of *P. runcinatum* DON (fig. 23). On Mt Kerintji were found minute fruiting specimens of *Aralia ferox* BL. which I have distinguished as f. *nana* (3).

*Cited literature:* (1) TEYSMANN, Nat. Tijdschr. Ned. Indië 32 (1873) 84; DUNSELMAN, De Trop. Natuur 27 (1938) 97-104. (2) Bull. Jard. Bot. Btzig III, 17 (1948) 389. (3) Bull. Jard. Bot. Btzig III, 17 (1948) 394.

#### 16. Solfatara plants

Specimens collected in craters are often of a surprisingly dwarfed habit even when old. SCHRÖTER (1) figured a dwarf plant of *Vaccinium variegifolium* MIQ. of East Java which was probably 50 years old and had the appearance of some alpine 'Spalierstrauch'. At a short distance from these strongly insulated, edaphically dry and often wind-swept barren rocky places on slopes or summits, the same species occurs in hollows or other sheltered places as well-developed shrubs or small trees. The dwarf shrubs of craters are often wholly appressed to the soil (with rooting branches!), with a matted and prostrate habit. Owing to the poisonous gases emitted by the solfatara or effect of the wind on ridges, their surfaces are flat and look as if clipped

or pruned (2) (fig. 21, 24). The solfatara may shift its outlet and so release these plants from its influence: I found some partly grown into a fresh bush, proving that the plant had recently escaped from the reach of the gases, the prostrate section being the oldest part. The reverse may also occur; erect shrubs may be affected later by crater gases (3) which makes them one-sided (fig. 25).



Fig. 21. *Vaccinium variegifolium* MIQ. (Eric.) as poor prostrate shrubs ('Spaliersträucher') near Kawah Idjen, E. Java, ca 2000 m alt. Exceedingly poor, eroded, very young volcanic soil. This species also grows in the mountain forest on the ridge behind in ca 3-6 m tall trees.

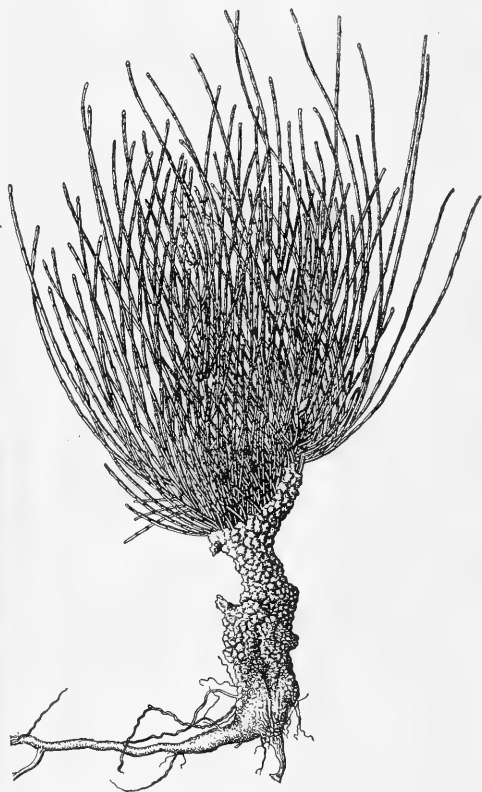


Fig. 22. *Casuarina junghuhniana* MIQ. (Casuar.). Old dwarf from the summit of Mt Agoeng, Bali Island, 3100 m, on a rocky windswept cone,  $\times 1/2$ .

Solfatara plants thus represent forms different in habit, and herbarium botanists must handle these materials cautiously. In a general sense the 'poor soil'-conditions cause nanism.

In Malaysia adaptability to habitat and variability in habit under extreme conditions is far greater than the average herbarium botanist suspects. It is difficult to interpret aberrant specimens from remote regions without a thorough field knowledge. Unfortunately this has led to the description of many 'paper species' which may seem specifically distinct but, when studied under various natural environments appear gradually to merge in the range of modifications existing in many Linnean populations.

*Cited literature:* (1) Vierteljahrschr. Naturf. Ges. Zürich 73 (1928) 584. (2) De Trop. Natuur 24 (1935) 142-144, fig. 2-5. (3) SO<sub>2</sub>, H<sub>2</sub>S, Cl<sub>2</sub>, &c.

### Hydro-morphosis

#### 17. Water- and swamp plants

Phenotypic variations comparable to those known in Europe are also known in the Malaysian flora. *Jussieua repens* L., when growing on muddy soil



Fig. 23. *Polygonum runcinatum* DON. (*Polygon.*). Below: apex of a normal plant. Above: a very uncommon form of Mt Argapoera (Jang massif, E. Java) from clefts in rocks (St. 10960),  $\times 2\frac{1}{2}$ .

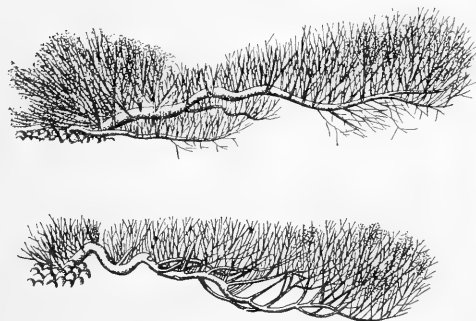


Fig. 24. Sketches of prostrate clipped habit of shrubs in the crater of Mt Papandajan, W. Java, ca 2000 m, through the combined action of wind and sulphurous vapours from solfatara. Above: *Vaccinium varingifolium* MIQ., below: *Rhododendron retusum* (BL.) BENN. (*Eric.*) (drawn after photographs).

through the lowering of the water level, changes into a conspicuously different land form with minute hairy leaves and very condensed habit; it takes some time to recognize this land form (1). Land forms are also known in *Potamogeton*, e.g. from Sumatra, and in *Utricularia*.

Of *Neptunia plena* BTH. a land form is known. BACKER suggests that the endemic *N. javanica* MIQ., a terrestrial endemic species in Java, is merely a land form of the common *N. oleracea* LOUR. (2).

*Limnophila sessiliflora* BL. and *L. indica* (L.) DRUCE, in shallow water, have deeply divided leaves below the surface with gradual transitions to lobed and toothed upper leaves above the water level. In very deep water pinnatifid leaves predominate, but in marshy grass fields only pinnatisect to dentate leaves are present.

The amount of aerenchyma is closely related to the depth of the water.

Many swamp plants fail to flower in deep water, but come rapidly into bloom when the water recedes (*Lemna*, *Blyxa*, *Pistia*, *Azolla*, *Salvinia*, *Marsilea*, &c.).

Swamp forest trees are also affected by the amount of water in the soil. A conical base to the trunk, so well known in *Taxodium*, is found frequently in other swamp species e.g. in *Gluta reinghas* L., *Alstonia spathulata* BL., &c. but, in non-inundated soils, the swollen base of the trunk is not or scarcely developed.

The same is true of aerial roots at the base of the trunk. In deep swamps they may resemble the stilt roots of mangrove. Such roots may not develop in the same species when it is growing on dry land e.g. *Acmena (Eugenia) operculata* (ROXB.) MERR. & PERRY. Root production in these cases is doubtless a direct response to the habitat.

*Cited literature:* (1) De Trop. Natuur 2 (1913) 83, fig. 3. (2) Schooflora voor Java (1911) 428.



Fig. 25. Oblique growth of *Vaccinium varingifolium* MIQ. caused by sulphurous gases of the crater of Mt Papandajan, W. Java, ca 2000 m alt., ca 1 m high.

## Phyto-morphosis

## 18. Fungus and bacterial diseases, and symbiosis

Malformations caused by fungi have led to some errors in identifying Malaysian plants. *Loranthus maculatus* BL. is, according to DANSER, the common *Dendrophthoe pentandra* MIQ. with a fungus on the leaves causing black spots (1).

In specimens of *Cassytha filiformis* L. from New Guinea Dr HATUSIMA found some tetramerous



Fig. 26. Pseudo-flowering of bamboo; galls caused by *Epichloe treubii* (Fungi). Bot. Gardens, Buitenzorg, Java.

flowers with a central column marked by little pits. The slender inflorescence was glabrous and the rest of the plant hairy. It was evidently a malformation caused by a *Peziza*-like *Ascomycete*.

Root deformities caused by *Cyanophyceae* are found in *Cycas*, *Gunnera*, &c.

Structures like witches' broom are often found in bamboos, and often regarded as immature flowering parts. These pseudo-flowers are galls caused by a fungus (fig. 26).

A curious malformation in *Pilea trinervia* WIGHT consisting of conspicuous swellings of the internodes was described by Mrs WEBER VAN BOSSE (2) and is caused by a parasitic alga: *Phytophysa treubii* W. v. B.

In *Pavetta*, bacteria cause dark often thickened spots in the leaves. According to BREMEKAMP the symbiosis is mostly restricted to particular species. Similar bacteria are found in species of *Psychotria*,

*Ardisia*, the tips of the leaves of *Smilax*, &c. The presence of absence of bacterial nodules is used in the identification of *Rubiaceae*, a rather singular method.

*Cited literature:* (1) Compare BOEDIJN, Bull. Jard. Bot. Btztg III, 13 (1935) 497-501, fig. 1. (2) Ann. Jard. Bot. Btztg 8 (1890) 165-186.

## Zoo-morphosis

## 19. Ant plants (myrmeco-morphosis)

Several Malaysian plants are inhabited by ants. TREUB (1) proved that the cavities in which the ants live in the tubers of *Myrmecodia* and *Hydnophytum* are also formed in the absence of ants.

In other instances, however, ants presumably bite their way into internodes and remove and carry away the pith. This was shown to occur in *Endospermum moluccanum* T. & B. (*E. formicarum* BECC.) by DOCTERS VAN LEEUWEN (2); I am able to confirm this. DOCTERS VAN LEEUWEN also found some specimens uninhabited by ants. In *Endospermum*, therefore, whether the internodes are hollow or not is certainly not a good specific distinction, though used by PAX in his key to the species of

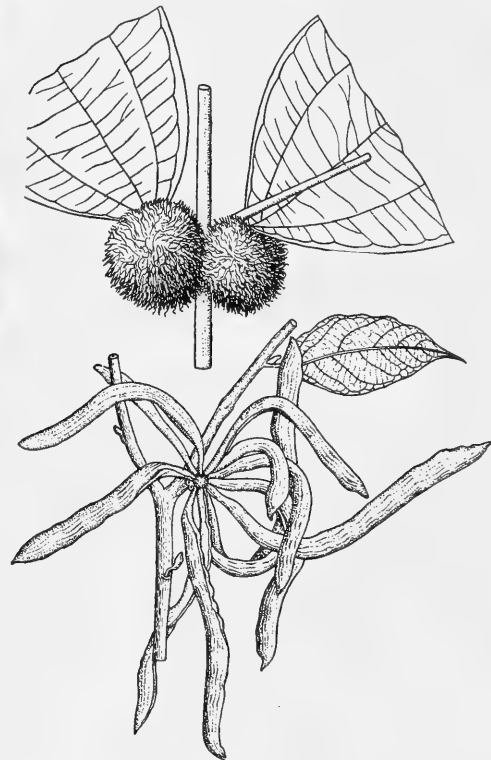


Fig. 27. Above: *Kibessia sessilis* BL. (Melast.) being based on a galled swollen fruit of *K. azurea* BL. (W. Java). Below: peculiar galls of *Styrax benzoin* DRYAND. (*Styrac.*) from Sumatra,  $\times \frac{2}{3}$ .

*Endospermum* subg. *Capellenia* (3). Moreover, as the other character used by PAX, viz the number of cocci in the fruit, varies from 3–5, through ignorance of data on points the collector ought to have noted on the label, the whole key breaks down.

In *Wightia borneensis* HOOK. f. some individuals are attacked by ants which remove the pith from the upper internodes. The withdrawal of the inner tissue causes the hollow internodes to assume a cigar-like shape.

*Cited literature:* (1) Ann. Jard. Bot. Btzg 3 (1883) 129–153. (2) Treubia 10 (1929) 1–7. (3) Pfl. Reich Heft 52 (1912) 34.

## 20. Galls deceptive to phytophagors (*cecidio-morphosis*)

*Cecidia* caused by animals have sometimes deceived botanists when describing plants. An example is *Ceratostachys arborea* BL., a genus based on a galled fruit of *Nyssa javanica* (BL.) WANG.

*Kibessia sessilis* BL. is merely the galled and enlarged fruit of *K. azurea* BL. (fig. 27).

According to RIDLEY (1) *Apterion lanceolatum* KURZ, described as a distinct genus, is identical with *Ventilago kurzii* RIDL.; KURZ mistook some insect galls for the ripe fruit.

MIQUEL described (2) an abnormal tree from Sumatra which was actually a species of *Styrax*, a genus in which most peculiar galls (fig. 27) are very common.

*Otopetalum micranthum* MIQ. is an *Apocynaceae* described from Java. According to BOERLAGE (3) the plant was referred to the wrong tribe because MIQUEL erroneously took galled flowers for 1-seeded berries; the former author suspects that it is related to *Micrechites*.

Insects (mostly cicads and larvae of Hemiptera) cause a singular malformation of the flowers in some species of the genus *Sterculia*. H. C. CAMMERLOHER (5) observed that they are attracted to so-called 'sugar hairs' which occur on the inside of the perianth. The insects injure both the hairs and the outer tissue in an early stage of development of the flower. The calyx becomes enlarged, thicker and tough, and opens hardly in anthesis; its lobes remain short and triangular, and the tube is relatively large. These flowers are conspicuously different from the normal 'uninhabited' flowers and, according to ADELBERT (6), ought not to be used when describing or identifying plants.

BACKER (7) described in *Hibiscus schizopetalus* (MAST.) HOOK. f. malformations of the vegetative parts and of the flowers caused by plant lice.

The Philippine species *Euphoria malaanonan* was described by BLANCO and by him referred to *Sapindaceae* but MERRILL stated (8) that it is merely based on specimens of the echinate galls of *Shorea guiso* BL. of the *Dipterocarpaceae*.

W. M. DOCTERS VAN LEEUWEN has published (4) an illustrated book on zoocecidia of Indonesia.

*Cited literature:* (1) Flora of the Malay Peninsula 5 (1925) 300. (2) Linnaea 26 (1853) 285. (3) Hand-leiding Fl. Ned. Ind. 2<sup>e</sup> (1899) 380. (4) The Zoocecidia of the Netherlands Indies, Batavia 1926;

Supplement, Ned. Kruidk. Arch. 51 (1941) 122–251. (5) De Trop. Natuur 22 (1923) 147. (6) In BACKER, Flora van Java, Nooduitg. IVb (1944) fam. 107, p. 18. (7) Flora van Java, Nooduitg. IVC (1943) fam. 109, p. 27. (8) Spec. Blanc. (1918) 33.

## 21. Influence of browsing animals (*pascuo-morphosis*)

In some parts of Malaysia browsing cattle and deer (1) can induce changes in the morphology of plants which might be termed *pascuo-morphosis*. In



Fig. 28. *Casuarina junghuhniana* MIQ. (*Casuar.*) on Mt Jang, E. Java; crown trimmed below by deer.

the deerpark of the Buitenzorg Palace, deer regularly feed on the pendent air roots of *Ficus* and prevent them from reaching the soil. The trees therefore remain single-stemmed and do not form thickets of pillar-like roots.

A similar effect is caused by deer on Mt Jang, in East Java, where deer eat the hanging branches of *Casuarina junghuhniana* MIQ. as high as they can reach (fig. 28). The trees look as if clipped (2) at the underside of the crown like those on the lawns at Buitenzorg. Much the same was observed on Mt Rindjani, Lombok Island (3). The broom-like appearance of the grass *Pogonatherum panicum* HACK. on Mt Diëng was ascribed to grazing cattle by the late Mr LOOGEN (4), an excellent amateur field botanist.

Browsing of animals has in general the same effect on the vegetation as frequent burning: the plants acquire a low habit and flower at an early age (*pseudo-nanism*). This occurs very commonly on the closely cropped fields of fine grass of Mt



Jang. It is only in hedges, on steep slopes or somewhere out of reach of deer that plants grow to normal dimensions.

In Central and East Java, and the Lesser Sunda Islands *pascuo-morphosis* is due to browsing of cattle in the dry season; it is known in *Zizyphus jujuba* L., *Streblus asper* L. and other shrubs. These assume a fastigiate habit as high as the browsing animals can reach: above about 2 m the twigs are again spreading and form a globular crown.

A transition to anthropo-morphosis is the clipping and pruning of plants which can sometimes produce an aberrant habit. According to BACKER (5) repeated cutting of plants along roadsides produced a peculiar table-shaped densely branched

form in *Sida retusa* L. near Batavia. In the Lesser Sunda Islands cattle are sometimes fed in the dry season with leaves of trees, as is done in Africa. For this purpose the people lop the lower branches of trees in order that cattle may reach the foliage. This causes a tendency to umbrella-shaped trees. Deer may cause the same change of habit.

*Cited literature:* (1) Mentioned for India by HOOKER & THOMSON, *Flora Indica* (1855) 29. (2) *De Trop. Natuur* 21 (1932) 27. (3) *De Trop. Natuur* 30 (1941) 123. (4) *De Trop. Natuur* 30 (1941) 70. (5) *Flora van Batavia* (1907) 102.

### Anthropo-morphosis

#### 22. Influence of fire (*pyro-morphosis*)

The changes in habit and structural characters induced by fire were named *pyro-morphosis* by PERRIER DE LA BÂTHIE who made observations in the island of Madagascar. In Malaysia there are few reliable data. One of the changes induced by regular burning of the vegetation is that plants are stunted, and flower when small.

Owing to the damage done to the surface part of the plant the underground parts thicken, and the upper portion of the rootsystem and lower portion of the stem form gradually a thickened half-subterranean 'lignotuber', which sprouts after fires have swept the plains. I made some observations in the Indramajoe plains (W. Java), where species of *Grewia*, *Butea*, *Dillenia*, *Morinda*, *Phyllanthus emblica*, *Zizyphus*, &c. sprouted from these thickened bases (1) (fig. 29).

Some instances of phytographical importance have come to my knowledge. RANT found (2, 3) that *Psidium cujavillus* BURM. f. can originate spon-



Fig. 29. Seedling of *Butea monosperma* TAUB. (Leg.) sprouting in its 3rd year in the fire-swept savannahs of Indramajoe, W. Java, and developing a lignotuber,  $\times \frac{1}{3}$ .



Fig. 30. Park-like savannah in SW. Soembawa, trees with short boles and rounded crowns. (DE VOOGD)



taneously from root shoots of *Ps. guajava* L. It is distinguished from *Ps. guajava* L. mostly by differences of size. *Ps. cujavillus* BURM. f. must, therefore, be reduced to a sport of *Ps. guajava*.

Fire-resistant trees are often crippled beyond recognition. Plants described from semi-arid (4) regions where fires occur annually are sometimes known only in this crippled state, e.g. *Fordia fruticosa* CRAIB, from N. Siam, described (5) as a shrublet 40 cm tall. The late A. F. G. KERR, a most able and experienced field botanist, stressed in a note made in the field that the plant was growing in an area subject to fire; this may explain such a habit in this otherwise arboreal genus. The normal plant will, in all probability, prove to be a tree.

*Cited literature:* (1) De Trop. Natuur 25 (1936) Jub. nummer, p. 117–118. (2) Ann. Jard. Bot. Btzg 41 (1930) 27–32. (3) Natuurk. Tijdschr. Ned. Ind. 94 (1934) 112. (4) That is: regions which are periodically wet and dry, and show two distinct seasons coinciding with the monsoons. (5) Kew Bull. 1927, 60; Fl. Siam. En. I (1928) 395.

### 23. Pioneer plants

In the preceding paragraphs 9, 14–16, and 22, several examples have already been given of pioneer

plants. I am decidedly of the opinion that this term should not be restricted to plants peculiar to landslides and other bare soils. Trees settling in savannahs or devastated areas, epiphytes settling on rocks, &c. are just as well 'pioneer plants'. They constitute seral vegetation types. In the initial stages of revegetation forest trees may appear as pioneer shrubs, flowering and fruiting early. It is rather baffling to find *Schima noronhai* REINW. flowering and fruiting as a lax shrub 2 m tall, when one is familiar with the gigantic full grown tree in the forest (height sometimes over 50 m, columnar bole over 1 m diam.). BACKER found (1) near Batavia flowering specimens 15 cm tall of *Grewia microcos* L., usually a tree up to 17 m high. The same phenomenon can occur in *Adinandra*, various *Urticaceae*, *Leguminosae*, *Ulmaceae*, &c. In New Guinea some endemic species were originally described as tall trees but Mr BRASS has recently found them as gregarious pioneer shrubs in different seral vegetation types.

A promising shade plant, *Albizia sumatrana* STEEN., described from the Westcoast of Sumatra, was found to be a forest tree. In the plantations it is a weed tree flowering and fruiting at a very early age. In the forest, its native habitat, flowering is apparently suppressed by the deep shade, the seedlings grow into pole trees, slender and tall with a minute crown and real growth only starts when the crownlet emerges from the canopy. The behaviour and appearance of forest trees when growing in the open cannot be predicted. The adaptive capabilities of most Malaysian forest trees are unknown, though data on these points would be of great importance for practical forestry. See also chapt. 2 on precocious flowering, a phenomenon frequently observed in pioneer plants.

*Cited literature:* (1) Flora van Batavia (1907) 196.

### 24. Savannah trees

Trees of the savannah generally differ in habit from trees of the closed forest in their short bole and spherical crown (fig. 30). If young forest trees

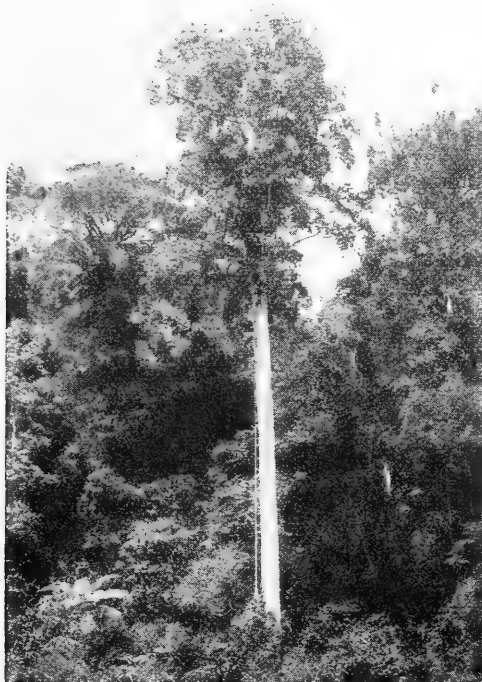


Fig. 31. *Altingia excelsa* NOR. (Hamam.) at Tjibodas, W. Java, ca 1450 m. Left: forest-grown tree, clear bole ca 25 m. Right: planted on the lawns of the mountain garden, at ca 200 m distance.

in deforested areas become exposed, or when they are planted as roadside trees, they acquire this shape: a striking example is *Altingia excelsa* NOR., a forest giant of the West Java midmountain forest between 600-1600 m. The clear bole is usually a characteristic feature of the tree; it is columnar, up to  $1\frac{1}{2}$  m in diameter, and up to 20-30 m from the ground unbranched (fig. 31). Specimens 50 years old, however, planted on the lawns at Tjibodas mountain garden, have grown into low spreading trees with hardly any bole at all (fig. 31). Descriptions of the habit of trees and shrubs taken from specimens grown in private and botanic gar-

dens, will therefore generally not agree with those taken from specimens in the forest. THORENAAR made similar observations in Javan oaks, and other trees such as *Podocarpus imbricata* BL., *Quercus*, etc. The habit of trees grown in open gardens resembles the shape of trees of the savannahs where the rounded crowns on a short bole often characterize the physiognomy of the open savannah forest. Physiologically this tree form is in all probability determined by the high amount of light present during the juvenile stages of growth. The crowns of mature forest giants exposed after deforestation also tend to become rounded.

## VARIATIONS BOUND TO THE GENOTYPE

### (Genotypic variation)

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Variation bound to the genotype is intimately related to the species concept and to geographical distribution. The ideas advanced by J. D. HOOKER in his introductory essay to the 'Flora Indica' (1855) have gained in 'philosophical' importance through the progress of basic research in experimental taxonomy in the last decades in Europe and the United States, in particular by E. BAUR, F. v. WETTSTEIN, N. H. NILSSON, G. TURESSON, A. MÜNTZING, Ö. WINGE, G. D. KARPECHENKO, B. H. DANSER, W. B. TURRILL, J. CLAUSEN, J. P. LOTSY, H. DE VRIES, N. I. VAVILOV, and many others. This work is summarized in several useful symposia and textbooks such as 'The New Systematics' edited by J. HUXLEY, CAIN's 'Foundations of Plant Geography' and CLAUSEN's *c.s.* 'Experimental Studies on the Nature of Species' (1945).

It lies outside the scope of this essay to consider the various view points on these subjects. Some of them I have already touched on in a study of Malaysian mountain plants.<sup>1</sup>

Now I will try to explain briefly some current views, including my own, and will illustrate them by examples taken from Malaysian botany.

#### 1. General remarks

Scientific names of species rest on the 'International Rules of Nomenclature' and depend on the identity of the 'type specimen'. This need not imply that only studies in which all type specimens have been

examined, full synonymy is given, in which nomenclature is in accordance with the Rules, and in which new species or other *taxa* have been described by careful Latin descriptions, are sound and durable. I know some excellent works in which nomenclature is neglected and synonymy is obsolete but in which botanical distinction and description are superb, and specific delimitation is carefully drawn. Such books give the impression that the author is master of his art.

I become more and more convinced that in the past two decades the care for outward appearance has come to take a too predominant share of the attention of some botanists who wrongly assumed that the examination of type specimens is the last word in real taxonomical research. It is sometimes not realized that *type specimens often are only deficient, poor and miserably dried single plants chosen at random from billions of specimens growing in Nature in the past, the present and the future*, which, together, according to the Linnean principle, compose the specific population. Very often these type specimens by no means represent the 'average' or 'most common type' of the population. The '*α*-typica'-distinction, therefore, has only nomenclatural, *i.e.* administrative but no botanical value.

It needs no comment that an up to date nomenclature is a *conditio sine qua non* for any taxonomic work, and it will be tried to reach a high standard in this Flora. At the same time, however, is it hoped that the contributors will not be satisfied when writing formally correct revisions, but also carefully consider the status of both genera and

species and the structural differences distinguishing them, not merely limiting themselves to the distinction of *taxa* for reasons of convenience.

Inadequacy of material and lack of field knowledge are both sources for the provisional distinction of 'species of convenience', which mark, in tropical floras, as a rule the initial stage of exploration.

Whilst the inadequacy of material is an insurmountable obstacle, and not every revisor will have the privilege to acquire field knowledge, a large fund of experience has been collected on the subject of variation in tropical plants.

The following pages contain a discussion, valuation, and illustration of variation in Malaysian plants.

In general the new systematics, based on modern experimental taxonomy holds that a narrow species concept is not in accordance with the structure of nature.

Modern insight offers no support to so-called 'splitters', one of whom declared to me as his 'principle' that he felt obliged to distinguish the smallest distinguishable entities and to assign to these a binomium. On the average the standard of the specific concept proposed by LINNAEUS in his works and rules cannot be questioned and for binomiums the Linnean canon has *priority of conception*. I fail to understand how that conscientious splitter who in matters of nomenclature adheres strictly to priority and applies the binomial system of LINNAEUS can simultaneously call wide-spread polymorphic populations 'collective species'. To do so is intentionally to depreciate the time-honoured and scientifically sound Linnean standards.

The difficulties confronting the systematist are manifold; no clue exists to the causes of polymorphy. Systematists are still far from being able to explain why some species are polymorphic and variable and why others show a narrow amplitude of divergency. This is a fundamental barrier to the methods of 'weighing and measuring', a common basis in the natural sciences generally. Polymorphy is apparently not related to speciation, as mono-specific units such as *Homo sapiens*, *Cocos nucifera*, &c. are very variable and species of large genera are sometimes not very polymorphic, though it will be observed that in most genera at least one species is widely distributed and rather polymorphic.

Ignorant of the laws underlying his taxonomic distinctions, the systematist should be aware that he deals with *unequal* entities, though we may try to shape them as consistently as possible.

A basic research in this connection is the work of the late E. BAUR, the geneticist, who made unsurpassed long-range efforts in the combined fields of taxonomy, field-work and experiments, to disentangle the genus *Antirrhinum* sect. *Antirrhinastrum* (1). This section had some dozens of local species described from the West Mediterranean distinguished by characters which were the despair of taxonomists. BAUR proved that the population of the section falls apart in numerous 'colonies' or 'partial populations' which are isolated and cross

mutually (*convivia*, *sensu* DANSEN). Each colony has its own type, the larger the colony the wider the local diversity (fig. 33c). All these local types can be freely intercrossed with fertile offspring, and there is no doubt that, if not isolated in nature, they would together merge into a still more diverse population with transitions and intermediates. BAUR, moreover, obtained experimentally many forms *not* realized in nature (*l.c.* p. 289), showing that the potential variability (2) or polymorphy (3), *i.e.* the total number of possible forms (genetic capabilities) is not exhaustively represented. There is a great *reserve* of possible combinations, and the genus manifests itself to us at present under a limited number of combinations.

Hardly any plant species is evenly spread within its area, and many occur in aggregates or colonies. BAUR's findings are thus of the utmost value for the Malaysian archipelago where isolation is a normal factor in specific populations, in the lowland owing to the insular discontinuous nature of this region and in the mountains still more accentuated by the often long distances between the summits. We cannot expect that the whole plant world will be subjected to accurate and thorough experimental research like BAUR's *Antirrhinum*-studies, but, judging from his results, it appears that *geographical distribution is an important argument when determining the status of taxa*. Well-defined allied species possess in general overlapping areas of distribution proving the independence of the populations. If, however, several allied species exclude each other geographically one must be on the alert, and check the differential characters again because the specific population may well be differentiated into a number of races, subspecies, or ecotypes.

Especially along the *frontier*—horizontal and altitudinal—of the area, a species population has a different *facies* from that at its centre. KERNER (4) showed that in *Cytisus* sect. *Tubocystis* aberrant forms occurred along the border of the area (fig. 33e). Migrating plant individuals (seeds, spores, fruits, root-stocks, &c.) carry only a part of the potential polymorphy of the genus, and their offspring will possess a special *facies*. Hence, along the frontiers, combinations can be expected which are not realized within the centre of the population. According to VAVILOV such pioneer aggregates are found to be recessive homozygous; this is of great practical importance.

It is worthy of note, as was pointed out by E. C. ANDREWS (5) that BENTHAM realized long ago that the geographical station of a waif or colonist imposes variations upon it almost from the moment of its arrival. ANDREWS adds, that Eucalypts planted in New Zealand, California, *etc.* present marked differences in general appearance from the same species in Australia.

Stimulated apparently by HOOKER (6), HUGO DE VRIES (7), the Master of experimental taxonomic botany, remarked that the initial stages of new species will be found most easily in luxuriant alien vegetations. His classic example, *Oenothera*, showed these 'mutations'—which they indeed are if the

mutation concept is accepted, in a wide sense, as a discontinuity in the sense of BATESON. In Malaysia, an example is perhaps the occasional occurrence, about 15 years after its arrival as a waif, of a yellow-flowered variety of *Gynura crepidioides* BTH. amongst the millions of specimens which possess the normal brick-red coloured capitules (8).

Anthropogenous *convivia* do not differ essentially in their behaviour from native *convivia*; they are partial populations isolated from breeding with the main population. Through inbreeding the partial polymorphy and the environment together will, in a few generations, determine the final composition of the colony or aggregate, and each *convivium* will represent a special local 'race'. Stray colonists or waifs from such *convivia* will show little differences in general in various localities, their characteristics having already been fixed. An experienced botanist thoroughly acquainted with a species is often able to determine the locality from which a specimen was obtained by means of its appearance.

Several aliens are known only as aliens and most probably represent combinations which do not persist in the parent population. Cultivated plants also are an essentially identical case. Kapok, *Ceiba pentandra* GAERTN., indigenous in the New World, is represented in the Old World by a subspecies, possessing recessive characters, which is not known in the New World (9). *Rumex obovatus* DANSER is a species known only as an alien, a nomad of the plant kingdom. Another example is *Kosteletzkya batensis* (BLCO) F.-VILL.; according to MERRILL (10) it was certainly introduced from Mexico into the Philippines in post-Columbian time, but is as yet unmatched by any known Mexican species. MERRILL states (11) that *Prosopis vitaliana* NAVES forms dense thickets immediately behind the beach in the Manila Bay region, and is also found in Basilan. It is unquestionably introduced from Mexico, probably from the vicinity of Acapulco, and was reduced to *P. juliflora* DC. by several authors but according to MERRILL it is not identical with it.

The genus *Elephantopus* is certainly not native in the Indo-Australian region; *E. scaber* L., however, is widely spread in Malaysia but found only as an alien (already recorded by BONTIUS, 1629) and apparently not known as a native species in the New World; it is alien there also (12).

A slightly different but interesting case is that of the New World genus *Turnera subulata* SM. (= *trioniflora* SIMS) and *T. ulmifolia* L. s. str. These two taxa, both alien in Malaysia (13), doubtless behave there as quite distinct species. In the West Indies, however, intermediate forms are so numerous that URBAN has not kept the two as separate species.

Among cultivated species selected by chance ages ago is e.g. a nearly etiolated form of *Pisonia sylvestris* T. & B., already mentioned by RUMPHIUS as 'Moluccan cabbage tree' and described as *P. alba* SPAN. It flowers seldom and differs considerably in habit from the rare wild form. Several *Pandanus* species cultivated in Java are unknown

in the fertile state. The cultivated clove, *Eugenia aromatica* O.K. has never been found wild in its native habitat, the Moluccas; the favourite clove of Zanzibar is derived from the Moluccan. The wild form of *Eugenia aromatica* O.K. is quite distinct from the cultigen in its much larger fruits, coarser foliage and lack of oil (9, p. 25). In the *Cucurbitaceae* and *Araceae* many forms are not known in a wild state, and their native country is unknown. The same applies to the coconut which is a very variable plant. BECCARI mentions peculiar forms of wild forest palms and other plants which he found selected and in cultivation only near the dwellings of the inland Dyak people in Borneo.

Another still unsolved problem is that of *Heliconia* (*Musaceae*) which occurs semi-naturalized in E. Malaysia. BACKER, who studied it, found that it was distinctly different from the American species (14). The plant was already recorded by RUMPHIUS.

The taxonomic units of the Malaysian flora next in rank to the genera are the species, that is, the specific populations. Their delimitation must be carefully considered. It is to be expected that the insular character of the Malaysian archipelago, its intricate geography, topography, and climate, and its complicated geological past, have given rise to great ecological variety and furnished ample opportunity for segregation within the limits of species populations. Sometimes adaptive segregation under special ecological circumstances can be traced. The majority of segregational phenomena remain unexplained at present.

In the following chapters some characteristic types of divergence in populations will be considered and examples given of each.

*Cited literature:* (1) Zeitschr. f. Ind. Abst. & Vererb. 63 (1932) 256-302. (2) HAGEDOORN, The relative value of the processes causing evolution (1921) 104. (3) DANSER, Ann. Jard. Bot. Btzg 40 (1929) 34. (4) Die Abhängigkeit der Pflanzengestalt von Klima und Boden &c. 1869. 48 pp. (5) Proc. 6th Pac. Sci. Congr. 4 (1940) 617. (6) Flora Indica (1855) 30. (7) Über das Aufsuchen von Artanfängen. Veröff. Geobot. Inst. Rübél 3 (1925) 567-570. (8) Current Science 8 (1939) 421; De Trop. Natuur 28 (1939) 173. (9) H. J. TOXOPEUS, Natuurwet. Tijdschr. Ned. Ind. 101 (1941) 23. (10) Enumeration Philip. Flow. Pl. 3 (1923) 41. (11) Enumeration Philip. Flow. Pl. 2 (1923) 251. (12) KOSTER, Blumea 1 (1935) 460. (13) De Trop. Natuur 20 (1931) 227-231. (14) Bull. Jard. Bot. Btzg III, 2 (1920) 315-319.

## 2. Peloric flowers

In addition to the *teratologo-morphosis* I have tentatively arranged under this heading examples of peloria in Malaysian plants, since these belong—at least partly—to the inherited type of variation. Future experimental breeding experiments will certainly elucidate their significance and *status* of which, at present, we are sometimes ignorant.

Peloric flowers have been described in various articles on tropical teratology by J. C. COSTERUS

& J. J. SMITH (1). They are specially common in Malaysian orchids, and have caused much confusion in phytopography. In actinomorphic flowers the spur is absent or nearly so.

The following examples taken from J. J. SMITH's compilation on teratological orchids of Malaysia (2), may serve as illustrations.

A Papuan orchid was described as *Aulostylis papuana* SCHLTR., a new genus. According to J. J. SMITH (3) it is the peloric form of a *Calanthe* (*C. papuana* (SCHLTR.) J.J.S.).

*Uropedium* LINDL. is synonymous with *Phragmopedilum* ROLFE.

The monotypic *Argyrorchis javanica* BL. (*Macodes javanica* HOOK. f.) is the peloric form of *Macodes petola* LINDL. var. *argenteo-reticulata* J.J.S.

*Labogyne* SCHLTR. is a teratological state of *Appendicula* BL.

The monotypic *Chlorosa javanica* BL. is probably a peloric form of *Cryptostylis arachnites* (BL.) LINDL.

*Chitonochilus* SCHLTR. is synonymous with *Agrostophyllum* BL.

The genus *Paxtonia* LINDL. is according to SCHLECHTER (4) a peloric form of *Spathoglottis*.

The genus *Eucosia* (*Euc. carnea* BL.) is possibly a monstrous form of *Goodyera viridiflora* BL.

*Dendrobium atavus* J. J. S. is a peloric monstrous form of an orchid unknown in the normal state, it approaches *D. normale* FALC.

*Epipogium roseum* (D. DON) LINDL. is often spurless and peloric.

Peloric forms have been described in *Dendrobium normale* FALC., some species of *Appendicula* (3), *Stereosandra*, *Agrostophyllum* (4), &c.

*Goodyera parviflora* BL. is probably a peloric of *F. procera* HOOK. f.

Of *Dendrobium tetradon* RCHB. f. a peloric form is common in Java of which the flowers mostly remain closed and are self-fertilized.

In *Oberonia imbricata* LINDL. the upper flowers of the spike are abnormal and the gynaecium is reduced.

Owing to the absence of a rostellum, autogamy is prevalent in several Malaysian *Orchidaceae* of which normal flowers are not yet known. This phenomenon has certainly a genetic basis.

Abnormal orchids with an enlarged number of anthers are sometimes also known only in that state (J. J. SMITH, l.c. p. 131).

Peloric orchids are often not known in their normal structure (J. J. SMITH l.c. p. 133-137). Sometimes the variation is geographic, e.g. in *Agrostophyllum denbergeri* J.J.S. which is in Java normal, but in Krakatau peloric.

In other cases it is peculiar to the individual e.g. in *Eria oblitterata* RCHB. f. which J. J. SMITH cultivated at Buitenzorg for a long time but remained peloric; it was later redescribed as a new species *E. isochila* KRZL. The same was the case with *Eria teysmannii* J.J.S. from Borneo, from which J. J. SMITH cultivated both a normal and a peloric form together; this plant also was described as a new species, *Trichotosia dajakorum* KRZL. A

peloric of the Sumatran *Dendrobium indragiriense* SCHLTR. was described as a separate species *D. isomerum* SCHLTR. J. J. SMITH assumes *Lecanorchis javanica* BL. to represent a peloric form of *L. pauciflora* J.J.S.

Peloric forms have been described in non-orchidaceous plants, e.g. in *Clitoria*. They have not yet been reported to my knowledge from Malaysia in other families with zygomorphic flowers as the *Gesneraceae* and *Scrophulariaceae*.

Discoid capitula of normally ray-flowered *Compositae* can also be regarded as peloric forms. Artificial keys to the genera fail when identifying such specimens. I suspect that some genera composed of species of reduced habit and subantarctic affinities may be only chance groupings of species occurring in the discoid form only.

These examples clearly show that the occurrence of monstrous forms presents a difficulty in identifying Malaysian plants. The fact that a single character has proved to upset taxonomy to such an extent that even new genera are based on these monstrous forms should encourage to more caution in the future.

*Cited literature:* (1) Ann. Jard. Bot. Btzg. vols 19, 23, 24, 28, 29, 32, 33, 34, 42 (1904-1931). (2) Natuurk. Tijdschr. Ned. Ind. 88 (1928) 122-140, specially p. 128, 131, 137. (3) Nova Guinea 14, p. 359. (4) Die Orchid. v. Deutsch Neu Guinea (1914) p. xlviii-xlix.

### 3. Other teratological or deviating forms

Phenotypic variation and inherited teratological and monstrous forms are often difficult to distinguish. Juvenile forms with lobed leaves, or with whorled leaves, and the like, are sometimes partly inherited, or the potentiality for producing them under certain ontogenic circumstances is inherited. This plastic variation is e.g. generally found in ferns where both dichotomous and lobed leaves occur in numerous genera. The tendency to lobing is sometimes even of racial character and may predominate in part of a population. In *Polypodium feei* METT., POSTHUMUS (1) found that the degree of lobation of the leaves gradually increases in Java from the West towards the East and the Lesser Sunda Islands, also from West Java towards North Sumatra (fig. 32). Forked leaflets frequently occur as individual variations, but, e.g. in *Asplenium dicranum* C. CHR. of Celebes, they are as far as known a regular specific character, even in mature specimens.

There is a clone of *Hevea brasiliensis* M.A. in Java always possessing large simple leaves when young; the total surface of these simple leaves is nearly equal to the combined surfaces of the leaflets in divided leaves. One-foliolate leaves occur in several genera with compound leaves (*Leea*, *Aglaiia*, *Allophylus*, &c.). A closer study of the ontogeny of these species seems to be needed.

An other phenomenon is found in *Boehmeria biloba* MIQ. (2) from Java, in which some specimens have forked leaves.

An example of a deviating form with variegated

leaves is *Coffea sundana* MIQ. from Sumatra; it is a variegated form of *C. arabica* L. *Pandanus variegatus* MIQ. was reduced by BACKER to *P. tectorius* PARK. as a variegated form; it remains sterile, and is only known as a cultigen. The soil has sometimes a great influence on the degree of variegation; poor soils stimulate the variegation in the leaves of *Caladium*, by manuring (N-compounds) this disappears to a large extent.

Hardly anything is known about these aberrant forms and experimental data are needed before a final conclusion can be drawn.

*Cited literature:* (1) De Trop. Natuur 25 (1936) 177-178. (2) MOR. Syst. Verz. (1845) 100, *syn. B. bifida* BL. Mus. Bot. II, 222, *non* WEDD., Ann. Sci. Nat. IV, 1 (1854) 199, from Japan.

#### 4. Distribution of the sexes

In the Malaysian flora many plants possess unisexual or polygamous flowers. The shape and size of flowers of different sex sometimes differ widely (*Mangifera*, *Hevea*, *Diospyros*, *Brucea*, &c.). The mode of distribution of the sexes is not homogeneous within a single genus, but differs from species to species, and even within one species (*Carica*).



Fig. 32. *Polypodium feei* METT. (*Polypod.*), a typical fern of a crater vegetation, *a*, from Mt Papandajan, typical W. Java form with entire leaves, *b*, from Moengal pass, E. Java, *c*, from Geli Moetoe, Flores Island. All specimens at ca 1500-2000 m (after POSTHUMUS),  $\times 1/5$ .

In *Casuarina* the beach 'tjemara' (*Cas. equisetifolia* L.) is monoecious, whereas the mountain 'tjemara' (*Cas. junghuhniana* MIQ.) is typically dioecious.

Sex is mostly dependent on a single Mendelian character and so the two sexes in dioecious plants will tend to be present in equal numbers; cases are known of a 3 : 1 proportion.

In polygamous plants where  $\sigma$  and  $\varphi$  and  $\delta$  flowers occur, the proportions are sometimes difficult to understand. Dr H. C. D. DE WIT recently found that in several species of *Eurya* no  $\sigma$  flowers are known (1). The distribution of the  $\delta$  flowers in this genus is peculiar; sometimes a few scattered  $\delta$  flowers occur among the  $\varphi\varphi$  on one twig, sometimes there are  $\sigma$  and  $\varphi$  twigs, but  $\delta$  flowers are always in the minority.

He also reports to me that in *Bauhinia malabarica* ROXB. the flowers have 10 stamens, as a rule all fertile. Sometimes all 10 stamens are reduced to staminodes; there are no intermediate stages, all stamens are either fertile or sterile. In all probability, if the stamens are reduced *all* flowers in one plant have reduced stamens. This induced BLANCO (16) to describe the female plants as *Bauhinia castrata*, and HASSKARL, unaware of BLANCO's name, again gave this the same name, *Bauhinia castrata* (17); now it was treated as a Javan species. ROXBURGH observed more or less the reverse in *Bauhinia acuminata*: in a number of flowers abortion of the ovary leaves the flowers male. WIGHT and ARNOTT (18) quoted GRAHAM's observation that 'for some reason (*Bauhinia malabarica*) has never borne fruit in the Calcutta Botanic Garden'.

In several species of *Dioscorea* BACKER (2) found male specimens much more common than female specimens.

HILDE SCHRÖTER & HUB. WINKLER found (15) in 100 sheets of *Elatostema rostratum* (BL.) HASSK., a common Javan species, the following remarkable figures for the distribution of the sexes: 4  $\sigma$ , 6 sheets with mixed  $\sigma$  and  $\varphi$  flowers in one axillary inflorescence, and 90 sheets pure  $\varphi$ . This is probably connected with apogamy which phenomenon was in other species recorded by TREUB.

In polygamous flowers it is often difficult to say whether the ovary remains rudimentary or not.

In *Arisaema* I found (14) a peculiar distribution of the sexes in the spadices;  $\sigma$  was predominant! In *A. filiforme* BL. I examined 108 spadices:  $\sigma$  75,  $\varphi$  31,  $\varphi$  2. In *A. barbatum* BUCHET I examined 36 spadices:  $\sigma$  29,  $\varphi$  1,  $\varphi$  6. Dr H. J. TOXOPEUS has suggested to me that in *Araceae* this might be due to the great loss of vegetable matter in the  $\varphi$  rootstocks and tubers through the production of seeds.  $\varphi$  and  $\delta$  plants would probably flower less frequently than  $\sigma$ . This is a very reasonable explanation, which must, however, be tested experimentally.

The *Ebenaceae*, numerous *Euphorbiaceae*, *Cucurbitaceae*, *Myristicaceae*, &c. are consistently dioecious.

These plants are often difficult to classify, and whether  $\sigma$  and  $\varphi$  flowered specimens ought to be referred to one species should be considered with great care. In most families the male flowers are more important, in others the female give the better

clue to the relationship. Descriptions based on inadequate material are, in dioecious genera and plants with uni-sexual flowers, decidedly insufficient. An example of the dangers involved in describing plants of one sex only is the following: BOERLAGE and KOORDERS described a small Euphorbiaceous tree from Sumatra on fruiting material only, and placed it in *Erismanthus* as *E. leembrugianus* BOERL. & KOORD. MERRILL, much later, described on flowering material, a new genus *Moultonianthes borneensis* MERR. The type specimens of these striking plants are identical. The confusion came from the fact that the subtribes of the *Cluytieae* are mainly separated on the structure of the male flowers.

In many cases two keys must be made for the identification, one based on ♂ and another based on ♀ characters.

In some plants it is still not known whether polygamy occurs. ENGLER (3) still supposed the flowers of *Weinmannia* to be bisexual, but KOORDERS and VALETON (4), BACKER (5), and the present writer (6) found polygamy at least in *W. blumei* PLANCH. and *W. clemensiae* STEEN. In *Myristica fatua* HOUTT. ♀ trees have sometimes some ♂ flowers and sometimes ♂. 'Male nutmegs' ('pala lelaki') were already known to RUMPHIUS; popular credulity caused them to be used as an aphrodisiac by the garrison at Sintang (7). These male nutmegs belong, however, to another species: *M. argentea* WARB.

In Malaysia several species are only known either as male or female plants. BACKER mentions that in *Lanea coromandelica* (HOUTT.) MERR. only female specimens occur, which fruit very seldom (5).

In *Garcinia mangostana* L. apparently only ♀ specimens are known to occur (8); according to BACKER (5, p. 91) male flowers have not been recorded in the past century.

Heterostyly occurs in quite a number of Malaysian plants. The Javan *Primula imperialis* JUNGH. is different from the Khayan *P. prolifera* WALL. only in having monomorphic (homostylous) sexual organs, and is therefore—in my opinion wrongly—kept specifically separate from the Asiatic race (9).

Several *Rubiaceae*, *Allaeophania* (10), etc., are heterostylous, of course also *Oxalis*. In heterostylous *Eichhornia crassipes* SOLMS (2, p. 41) only the medium-styled form is spread in Malaysia. Heterostyly also occurs in *Connaraceae* and in *Averrhoa* (11).

A strange case of abnormal geographical distribution of the sexes is found in *Balanophora globosa* JUNGH. This species is known from the Malay Peninsula and West Java, but in Java only the ♀ form is found and is according to LOTSY (12) apogamous. In the Malay Peninsula, however, both female and male plants have been collected.

Another case is that of *Brucea amarissima* DESV. which in Malaysia is mostly monoecious; in Central- and E. Java ♂ and ♀ specimens occur, according to BACKER (5, p. 192, footnote; 13). A similar peculiarity in geographical distribution of sexual forms is seen in *Lanea grandis* ENGL. of which the flowers are unisexual. The Javan specimens are all

dioecious, and only female specimens have been found (5, p. 281).

*Cited literature:* (1) Bull. Jard. Bot. Btzig III, 17 (1947) 332. (2) Handboek Flora Java pt 3 (1924) 109. (3) Nat. Pfl. Fam. ed. II, 18a (1930) 250. (4) Bijdr. Boomsoorten Java 5 (1900) 398, 401. (5) Schooflora voor Java (1911) 471–2. (6) Journ. Bot. 72 (1934) 5. (7) Geneesk. Tijdschr. Ned. Ind. 13 (1868) 361. (8) Science 92 (1940) 359. (9) Ber. Schweiz. Bot. Ges. 48 (1938) 156–165. (10) DOCTERS VAN LEEUWEN, Verh. Kon. Akad. Wet. A'dam 31 (1933) 232. (11) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 251–254. (12) Ann. Jard. Bot. Btzig 16 (1899) 174–185. (13) Flora Batavia (1907) 260. (14) Bull. Bot. Gard. Btzig III, 17 (1948) 449. (15) in FEDDE, Rep. Beih. 83, 2 (1936) 93. (16) Fl. Filip. 1 (1837) 337. (17) Flora 25 (1842) Beibl. II, 54. (18) Prodr. Fl. Pen. Ind. Or. (1834) 295.

#### 5. Geographical segregation in Malaysian specific populations

Geographic segregation is the fact that the hereditary characteristics within a population are not homogeneously distributed over the specific area. This uneven representation of the genom types manifests itself both morphologically and ecologically (physiologically).

It is clear that the pattern of the types in general will coincide with the pattern of the environments. The environment itself seems to a certain degree responsible for this coincidence or, in other words, the principle of tolerance of the plants is expressed by means of selection by the environment. In a large N-S directed area like North America the hardest types of a population will be found in the northern parts of its area and the southern types will, in all probability, be unable to stand a severe winter. Northern types planted in the south will, however, show other deficiencies and, probably, be unable to stand long hot summers. This has in fact been found experimentally in forest trees in the U.S.A. as Dr H. M. RAUP, professor of plant geography, Harvard University, kindly informed me. The same holds for altitudinal types within species of wide altitudinal range. In short, it is the rule wherever a widely distributed species has had to withstand differences in soil and climate.

It is not necessary *a priori* that physiological differences should create or accompany morphological differences. Ecologically distinct races, therefore, may not always be morphologically distinguishable; the differences may be 'invisible'. However, in practice in the majority of physiological races some minor morphological differences can be traced though they are not always clearly defined.

The wider a species has spread the more tolerance it has, apparently, towards various climates and soils, and the higher is, on the whole, its variability; these facts are causally related.

Valuable practical use can be made of this differentiation in a population. If seedling Eucalypts are required for afforestation in a rather wet climate, it is important to collect seeds from trees growing under conditions which closely approach



the conditions of the new forest. If *Pinus merkusii* JUNGH. & DE VR. is used for afforestation in the mountains seed collected at high altitude will give the best results; for afforestation in the lowlands seed-parents must be chosen at low, or the lowest possible altitude.

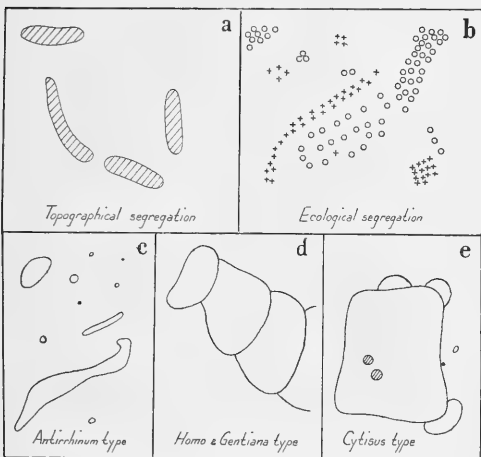


Fig. 33. Some imaginary types of racial differentiation:

- Topographical segregation:** the areas exclude one another by topographical barriers (seas, mountain ranges, deserts, etc.).
- Ecological segregation:** the subspecies or races exclude one another through edaphic factors, e.g. dry-land against inundated land, etc.
- Specific area consisting of a number of isolated colonies,** each occupied by a separate race, each colony with its own facies; no intermediates. *Antirrhinum* type.
- Specific area consisting of a number of regional exclusive races bordering on the area of neighbouring races.** Intermediates are found at the frontiers shared by 2 types. Frequent type of segregation in birds and butterflies. *Homo* and *Gentiana* type.
- Widely distributed specific population with marginal and/or altitudinal races or subspecies.** The shaded areas represent altitudinal races. *Cytisus* type.

It is a striking fact that the amplitude of ecological behaviour is very narrow in some large and widely distributed genera. Examples are *Primula*, *Gentiana*, *Geranium*, *Pedicularis*, &c.; all are strictly microtherm. Apparently their basic genom pattern lacks the potentiality to produce derived types able to withstand a constant high temperature. In the tropics they occur only at high altitude.

This contrasts sharply with equally wide distributed genera like *Quercus*, *Hydrocotyle*, *Myrica*, *Hypericum*, *Ajuga*, *Salvia*, *Rosa*, *Vaccinium*, &c. which are essentially temperate but also contain tropical lowland species.

In some genera only certain sections possess this

potentiality in their genom pattern, e.g. *Carex*, *Rubus*, *Clematis*, *Daphne*, *Lobelia*, &c. (1).

The same applies to the capacities of megatherm families and genera. In the large family of *Dipterocarpaceae*, occurring from the Himalayan tracts and Ceylon to the Louisiades, no species is able to withstand cold; in Malaysia hardly any species oversteps the 1000 m contour.

Other genera, though typically tropical, such as *Calophyllum*, *Garcinia*, *Symplocos*, *Pandanus*, &c. have produced a number of species occurring at high altitude in the tropics. It is remarkable that these have mostly *not* spread into temperate countries but remained in the tropics.

Within specific populations there are three types of racial or subspecific differentiation.

Firstly there is *segregation of parts of the populations by different ecological stations*. The segregates may occur in the same geographical area but are confined to restricted habitats; so, as regards distribution, they form two or more complementary mosaic patterns in the same area. This type of segregation is mostly due to differences in edaphic conditions (fig. 33b).

Secondly *the areas occupied by the subspecies may be regional, and the areas exclude each other either altitudinally or horizontally*, but their frontiers touch as in a jigsaw puzzle. This kind of segregation is mostly due to climatic conditions (fig. 33d).

Thirdly *the areas of the subspecies or races may exclude each other as in the second case but their frontiers do not touch each other as the subspecific areas are separated by topographical conditions* (fig. 33a).

In one species more than one type of segregation may be present, e.g. in *Impatiens platypetala* LINDL. (2). The 'normal' form in Java of this widely distributed species has large purple flowers; it favours moist places, descending seldom below 500 m (mostly along streams and only in continuously wet climates); it ascends to 2500 m alt. In Central and East Java another form occurs, named by MQUEL *I. nematoceras*; this occurs mainly in the northern portion of Java from Cheribon eastward in grass fields between 50 and 850 m alt. and is confined to regions subjected to a dry season; it is also found in Madoera and the Lesser Sunda Islands. In habit it is frail and lank, its leaves and purple flowers are always smaller and rather typically ephemeral in appearance; it is the only *Impatiens* found in teak forests and the only species known from dry Madoera Island (fig. 34). The 'normal' form and *I. nematoceras* exclude each other geographically and differ in habitat (climatic and altitudinal) and build (mostly size). Intermediate specimens are very scarce; I myself have seen none. The differential characters are certainly not of specific rank and both BACKER and I are convinced that *I. platypetala* and *I. nematoceras* are races of one population i.e. regional subspecies; here differentiation results in two climatically limited areas.

In Celebes there is a third race, confined to that island, with slightly smaller, plain orange coloured

flowers, formerly described as *I. aurantiaca* T. & B. ex KOORD. and as *I. celebica* MIQ. This form differs from the others practically only in the colour of the flowers, hardly by any structural characters. This is clearly an instance of a topographical race, belonging to type 3. It has a similar ecology as the 'normal' *I. platypetala* in Java.

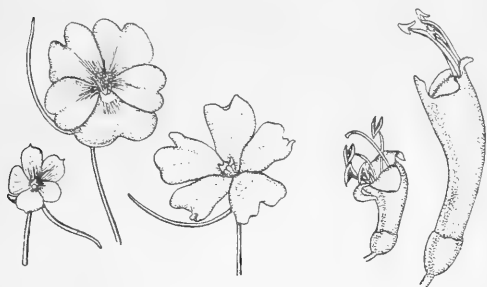


Fig. 34. Left: flowers of 3 subspecies of *Impatiens platypetala* LINDL. (Bals.), from left to right: *ssp. nematoceras*, *ssp. genuina*, *ssp. aurantiaca*. Right: flowers of the two Malaysian subspecies of *Wightia borneensis* HOOK. f. (*Scroph.*), from left to right: *ssp. ottolanderi*, *ssp. genuina*,  $\times 1/2$ .

The study of the problems connected with raciation are in Malaysia far less advanced in botany than e.g. in entomology, and our knowledge is mostly based on field observations and herbarium study, rarely on experiments.

The examples given in the following chapters must, therefore, be considered in the light of this fact.

(a) *Ecological segregation (mostly edaphic ecotypes, races or subspecies)* (fig. 33b). Under this heading some examples of ecologically segregated populations will be enumerated. The areas of the races or subspecies overlap, but if the boundaries are accurately marked on a map their growing localities exclude each other, forming a mosaic pattern. Only a very few cases have been mentioned in literature or have come to my knowledge, and the intimate relationships have not yet been studied in the field and experimentally.

*Hanguana* (*Susum*) is a genus of *Flagellariaceae* of which two species have been distinguished in Malaysia, viz: *H. anhelminthicum* BL. and *H. malayanum* (HOOK.) MERR. The former is a characteristic gregarious swamp plant of deep water in most parts of Malaysia. It produces numerous stolons and its inflorescences are large and stout,  $1\frac{1}{2}$ –2 m tall with glabrous panicles and flowers inserted on lateral branches of second and third order.

*H. malayanum* is a typical terrestrial forest plant of much smaller dimensions. It does not produce stolons during anthesis; only one stolon is formed after the setting of fruit. It is never found in flooded or temporarily flooded places and is not gregarious (presumably owing to the absence of stolons); it is 40–100 cm tall. The panicles are at first more or

less hairy, later glabrescent. The flowers are inserted mostly on branches of the first partly also on those of the second order. These distinguishing characters seem small and inessential, but the plants can be separated quite easily both in the herbarium and in the field (3).

In Java no transitions have been found but BACKER says they occur in Sumatra (4). In Java, therefore, the two plants behave as good species, but not in Sumatra. BACKER therefore reduced them to the rank of 'forms', in the sense of races or subspecies which is, as far as our knowledge goes, apparently the appropriate status.

A more or less gradual geographical change in a population is found in the fern *Polypodium feei* METT. as shown in fig. 32.

Among the grasses endless varieties and forms have been distinguished, according to BACKER's excellent treatment of the Javan members of this family. In general they exclude each other horizontally. There are also ecological races, e.g. in *Coix lacryma-jobi* L., a polymorphous species cultivated from early times and doubtfully native in Malaysia. The common form is *f. agrestis* BACKER (*C. agrestis* LOUR.), *f. ma-yuen* STAFF is only cultivated. In the Danoe swamp in W. Java there is a tall ecotype *f. palustris* BACKER (*C. palustris* KOORD.), in the Pening swamp in Central Java another form with floating stems *f. aquatica* BACKER (*C. aquatica* ROXB.) and in N. Sumatra near Toba Lake still another form, *f. ouwehandii* (KOORD.) BACKER; all these are distinguished by minor morphological characters. The floating habit seems far from constant, as the Pening form when cultivated at Buitenzorg gave an erect strongly stooing plant 1 m high (4).

A form of *Spinifex littoreus* (BURM.) MERR. is recognized as *var. longifolius* BACKER (formerly distinguished as a distinct species *Sp. longifolius* R. BR.). It occurs in the Lesser Sunda Islands and E. Java, and in Australia. BACKER (4, p. 188) says that this variety is usually easy to distinguish from the main type, but generally does not grow mixed with it and apparently occupies a slightly different habitat. He also found intermediates.

A typical ecotype in Java is a very slender brittle form of the variable common weed *Emilia sonchifolia* (L.) DC. with narrow-lanceolate to linear leaves. It has been described as *E. flaccida* MIQ. but its real status is still unknown to me; it may be identical with *E. angustifolia* (WALL.) DC. which is sometimes reduced to *E. prenanthoidea* MIQ. It is very distinct in the field and seems to be definitely native, though in Java the common weed *E. sonchifolia* is an introduced alien, along roadsides, in fields, gardens and plantations. The form described as *E. flaccida* MIQ. occurs in Java only in the marginal reed and sedge vegetation of mountain swamps and lakes.

Another case is that of *Melaleuca leucadendron* L. which is a variable plant throughout its area in Queensland and Malaysia, apparently split into races or subspecies. In East Malaysia at least two subspecific entities occur, viz a dry-land savannah form from which the essential 'kajoe poetih' oil

is prepared in the islands of Boeroe and Ceram, and a form confined to forested swamps. In New Guinea both forms occur, but strictly exclude each other as regards habitat. In West Malaysia (Sumatra, Malay Peninsula, Borneo, West Java) only the swamp race is present. The latter does not yield essential oil for commercial purposes. Morpholo-



Fig. 35. Leaf types of the two races of *Macrosolen pseudoperfoliatus* MIQ. (Loranth.). Left: a pair from Mt Ardjoeno, right: 2 leaves from specimens of Mt Tengger,  $\times 1/2$ .

gically the swamp forest race has broader leaves than the savannah race; but otherwise the differences are trivial.

(b) Regional segregation.

(b<sup>1</sup>) Horizontal segregation (mostly climatic ecotypes) (fig. 33d, e). An illustrative example is the Loranthaceous *Macrosolen pseudoperfoliatus* (ZOLL.) MIQ. which DANCER says (5) is endemic in East Java on the two neighbouring mountain massifs Tengger and Ardjoeno. The forms on each massif differ strikingly only by the shape of the leaves, which in Ardjoeno specimens is lanceolate or ovate-lanceolate with attenuate base, but in Tengger specimens cordate-amplexicaulous (fig. 35). No intermediate forms occur, but as no floral differences have been observed, DANCER does not separate them. This is certainly a very instructive case of racial differentiation, though unexplained, as the climate, altitude, &c. of these mountains are exactly alike.

A remarkable case is that of *Wightia* (21), a woody genus of the *Scrophulariaceae* (fig. 36). A thorough study revealed the length of the corolla as the only really constant difference between the two Malaysian species described: *W. borneensis* HOOK. f. from Borneo, and *W. ottolanderi* KOORD. from E. Java (fig. 34). This character is sufficient to separate the forms easily and no intermediates have been found. The distributional data also demonstrate, however, a peculiar difference in ecology, as *W. borneensis* (elongate corolla) is only found in the rain forests and forest margins of

Borneo, the Malay Peninsula, Sumatra, and West Java, whereas the small-flowered *W. ottolanderi*, occurs only from Central to East Java and in the Lesser Sunda Islands in places subjected to a pronounced dry season during the East monsoon. No immediate adaptive relation seems to exist between the morphology and the climate; the foliage is similar, and both species are deciduous. I accept them as of subspecific rank.

Racial differentiation is also described in *Alangium* by BLOEMBERGEN (6) viz in *A. salvifolium* (L. f.) WANG. of which *ssp. decapetalum* is known from the Comores to SE. Asia and *ssp. sundanum* from the SW. part of the Deccan peninsula, Ceylon, the Andamans, and Malaysia. According to BLOEMBERGEN's map (6, p. 148) the subspecies exclude one another completely.

The subspecies of *Polygonum* apparently have no ecologically different habit. In *Polygonum barbatum* L. DANCER (7) distinguishes a *ssp. gracile* differing from the main population by a slenderer less ramose habit, less numerous spikes, and somewhat narrower leaves with rotundate or cordate base. It does not differ, however, in geographical distribution and even occurs in the same spots as the main species. This is certainly not a subspecies in the present meaning. Similar subspecies are distinguished in *P. caespitosum* BL. DANCER found intermediates fertile with the main population and this prevented him from accepting it as a separate species. *P. caespitosum ssp. yokusaiianum* is known only from Sumatra; DANCER supposes this to be a subspecies, that is, in his sense, a clearly distinguishable but not sharply separable race with a certain measure of independence, behaving locally like a



Fig. 36. Distribution of the genus *Wightia* (Scroph.), the shaded area is that of *W. speciosissima* (D.DON) MERR. sens. ampl. The  $\pm$  disjunct Malaysian species consists of 2 subspecies of *W. borneensis* HOOK. f.; dots: *W. borneensis s.str.* and crossed dots: *ssp. ottolanderi*.

species. Judging from the localities there is no apparent difference in ecotype. In *P. pulchrum* BL., DANSER distinguished one subspecies, *hallierii*, from Borneo, which is the only representative of the species in Borneo; it is therefore a marginal race.

In *P. minus* HUDS., DANSER has arranged all Malaysian specimens in 5 different subspecies mostly based on 5 former species. Several are clearly connected by intermediates. In mapping the subspecies it appears that *micranthum* and *depressum* are both practically limited to Sumatra-Malacca-Java, *procerum* is exclusively found in Borneo and from there eastwards, *subsessile* is found in New Guinea and Australia; forms intermediate between *subsessile* and the Australian *decipiens* also occur in New Guinea. Between *subsessile* and *procerum* there are intermediates in New Guinea. These subspecies exclude each other geographically quite consistently and have the character of races.

In *P. hydropiper* L. there is a peculiar geographical racial differentiation. The large-fruited *ssp. megalocarpum* is found in the temperate regions of Europe and Asia, and in temperate Australia. The tropics in between have only the small-fruited *ssp. microcarpum* which is represented in Malaysia by the lenticular-fruited variety occurring in Malacca and N. Sumatra, and further only by the triquetrous-fruited variety. This is a distinct geographical segregation; the large-fruited subspecies is found only in the temperature outposts of the distributional area.

In *P. pubescens* BL. (SE.-E. Asia and Malaysia) a subspecies *prianganicum* is distinguished, occurring only in the mountainous W. part of Java, but found together with the main population on some mountains there. There is no geographical segregation.

In *P. runcinatum* D. DON (SE.-E. Asia, Sumatra and Java) the main form occurs only on Mt Diëng (Central Java) while the other Javan specimens are distinguished as *ssp. javanum*. This subspecies is so different from the Asiatic population that DANSER would have raised it to specific rank had not some forms been found in Asia approaching *ssp. javanum*.

In *Pimpinella pruatjan* MOLK. all specimens found in its westernmost locality in Java, Mt Pangrango, have rooting inflorescences. Though I agree with BUWALDA in reducing *P. leeuwenii* WOLFF, which is based on this ecotype, to *P. pruatjan*, the fact remains that the trivial racial differences are probably hereditary (8).

In *Anaphalis javanica* SCH.BP., specimens found on Mt Tengger have a peculiar yellowish tomentum in the inflorescence, in contrast with the snow-white one of specimens from elsewhere. The ecotype is local.

In *Berberis* sect. *Mahonia* specimens from N. Sumatra (described as a separate species) differ from those of Java mainly in the very large leaves, but I believe both to represent two distinct races of *B. nepalensis* SPR. Scores of slightly different forms in Southeastern Asia have been described as 'species' by SCHNEIDER, FEDDE, and TAKEDA. It is astonishing to learn that these species are mostly known from one or a few specimens only. It is

significant that the area of these 'species' is local, and further that no overlapping of the areas occurs. The absence of a sound key to the species in TAKEDA's revision shows the feeble position of the distinctions which is further illustrated by his numerous drawings.

Racial differentiation in Malaysian plants is further described by WASSCHER (9) in *Podocarpus*, by VAN OOSTSTROOM (10) in *Evolvulus alsinoides* L., by Miss KOSTER (11) in several genera of *Compositae*, e.g. *Centratherum* and *Vernonia*, by DE WIT (2) in *Eurya*, by BACKER (12) in *Forrestia* and *Gramineae*, and is further known in *Swertia*, *Malvaceae* and a number of other plants.

Exclusive areas of distribution do not always prove groups to be of less than specific rank. DANSER distinguishes in *Agathis* three species viz *A. borneensis* WARB. from Sumatra, the Malay Peninsula and Borneo; *A. alba* FOXW. from the Philippines, Celebes and the Moluccas; and *A. labillardieri* WARB. from New Guinea and adjacent islands. These three species exclude each other topographically and represent vicariads. According to DANSER each is differentiated in a number of ill-defined geographical variations.

(b<sup>II</sup>) *Altitudinally differentiated populations* (fig. 33e).—Altitudinal differentiation is often difficult to evaluate as in most species a distinct change in habit and foliage with altitude is observed which is certainly sometimes only a modification or adaptation; the leaves become smaller and more leathery, leaf margins tend to recurve, the blade grows broader proportionally, &c.

Transitional forms are often found between those of the hills and the summits. In the absence of experiments it is often difficult to judge whether the differences are of modificational, racial or specific rank. Characters of leaf and habit are, in my opinion, certainly not sufficient for specific distinction if there are no additional structural differences in the floral parts.

In Japan *Fritillaria camschatcensis* KER-GAWL em. SWEET occurs in two forms, viz a dwarf alpine ecotype and a lowland type. MATSUURA (13) has found the alpine subspecies to be polyploid and derivative.

A good example of an altitudinal subspecies in Malaysia is, I think, a peculiar form of *Schima noronhae* REINW. which was described from Mt Kinabalu as *Sch. brevifolia* HOOK. f. In 1937 I collected this small tree also in N. Sumatra (Losir highlands). Its leaves are rounded, crowded and sessile, its habit compact; I could not find sufficient floral differences, and STAFF also remarked that it was very closely allied to *Sch. noronhae* REINW., but a distinct series of intermediates was not found. For these reasons I have reduced this summit form to the rank of a subspecies (1, p. 51).

It is an unsolved problem whether these altitudinal subspecies behave distributionally as species, or whether they are a result of independent polytypic segregation on different mountain complexes; in the latter case they would be autochthonous polytypic segregations. There is, I believe,

only one way to solve this question, viz by means of a 'tracer'-character in the populations. Assuming that in the Bornean population of *Sch. noronhae* a small morphological character could be demonstrated which is absent in the Sumatran population, then this would point to polytopic origin of *ssp. brevifolia*. If, however, this 'tracer'-character were

summits) has some minute characteristic in common with West Java *spicata* (from the hills) which fails to occur in both Central Javan summit *sessilifolia* and Central Javan hill *spicata*.

A remarkable altitudinal segregation exists in *Dodonaea viscosa* JACQ. in Java; it is either found near the sea shore in a glabrous form or in the mountains, between 1100 and 3300 m, in a hairy form.

Other examples are species of *Cardamine*, and specially *Plantago major* L. s.l. The latter species has been described under various names from Java and elsewhere in Malaysia. Phenotypically it is very changeable but it has also certainly been segregated in local races. PILGER (14) has not been able to separate *P. asiatica* L. from *P. hasskarlii* DECNE and *P. incisa* HASSK. in his key. All species together form an exceedingly polymorphous ubiquitous population described under many names.

Altitudinal exclusion, on the other hand, is not always a proof that entities are of less than specific standing. This is demonstrated by the genus *Lonicera* of which only two native species occur in Java (15), both with good floral and vegetative characters. In fig. 37 I have marked the occurrence of the species on the summits of Java, and it appears that the altitudinal areas touch only on Mt Gedeh in W. Java where, however, no intermediates are found. This is clearly a case of altitudinal vicariism of two distinct species.

(c) *Topographical segregation* (historical raciation) (fig. 33a, c).—Under this heading I have arranged examples of type 3, that is subspecies, or races, excluding each other geographically but whose boundaries do not coincide, or touch. They remain separated by topography or mere distance. Naturally, Malaysia, consisting as it does mostly of islands, is topographically most suitable to this kind of segregation.

In the introduction to this chapter I mentioned that the purple-flowered Javan *Impatiens platyptala* LINDL. is represented in Celebes by an orange-flowered race (subspecies).

A similar more complicated racial differentiation was described by Dr BLOEMBERGEN in his revision (6, p. 197) of the genus *Alangium*, viz in *A. villosum* (BL.) WANG. in which he distinguished no less than 11 subspecies, mostly confined to a single island, island group, or part of an island.

In the genus *Pahudia* (now *Afzelia*) Dr DE WIT found that of *P. javanica* MIQ. a large-flowered form is found in Sumatra (Eastcoast Residency) far from the Javan population. The size of the flowers is the only reliable difference from the Javan species (16).

In the mountains topographical segregation is of very common occurrence. This is readily understood when it is realized that the flora of the summits is comparable to the plant-cover of scattered islets in a sea of lowland megatherm vegetation. Though apparently not so pronounced as in animals, in plants also all specimens from one summit or a mountain massif frequently show a certain local facies in minor characters. In *Primula proli-*

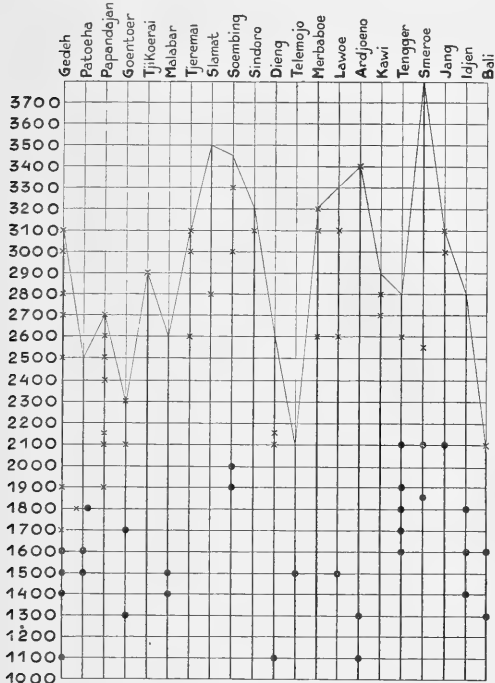


Fig. 37. Altitudinal localities (in metres) of *Lonicera acuminata* WALL. (X) and *L. javanica* (.) (Caprif.) in Java and Bali. Mountains arranged from W towards E. Thickened vertical lines indicate the altitude of the summits.

present only in the Sumatran highland *brevifolia* and not in the Sumatran lowland and hill populations of *Sch. noronhae* it would point to an independent distributional behaviour of *ssp. brevifolia*. The 'tracer'-character could, of course, equally well be present in the Sumatran population and Borneo *brevifolia*, but be absent from the Bornean hill and lowland populations. The solution of the question whether these altitudinal subspecies can emerge locally and independently from lowland populations requires a very detailed morphological study based on abundant materials and wide field studies. The outcome might have very important theoretical results.

In *Symplocos* closer study may give a key to this 'tracer' problem. The summit species *S. sessilifolia* (BL.) GÜRKE is distinguished from *S. spicata* ROXB. (= *S. laurina* (RETZ) WALL.), mainly by a condensed habit, and sessile or subsessile coriaceous broad leaves. The West Javan *sessilifolia* (from the

*fera* WALL. the Javan specimens from Mts Pangrango, Papandayan and Jang differ from one another in small characters (17). The form from Mt Jang, the most eastern extremity of the generic area in Malaysia, is also the most deviating! The Malaysian *Primula prolifera* population as mentioned above differs essentially from the remote Himalayan-Chinese *P. prolifera* only in its monomorphous-homostylous flowers (18) (fig. 38).

*Pleiocraterium*—preferably a section of *Hedyotis*—I found on two mountains in N. Sumatra about 80 km apart. The colonies were different in minor respects, which induced BREMEKAMP to recognize them as different species (19). This I am prepared to accept only if it is proved that they do not hybridize when growing in company. Moreover, I am firmly convinced that when the other summits in N. Sumatra have been searched, it will be found that each summit possesses its own race of *Pleiocraterium*.

A somewhat complicated situation exists in genera containing a widely distributed continental specific population which has spread into Malaysia by two different tracks (pincer-migration). An example is *Ainsliaea pteropoda* DC. which is found widely distributed in SE. Asia, in West Malaysia (Sumatra, and the Malay Peninsula) and in North Malaysia (Philippine Islands).

It stands to reason that the Philippine specimens originated from Formosan-Chinese sections of the continental population, and that the Malay Peninsula specimens migrated from the Burmo-Siamese section of the continental population. The continental populations of widely distributed species are often regionally divergent. It is thus to be expected that the Philippine groups will be somewhat different from the West Malaysian specimens. In fact they have been described under different names, but it is extremely likely that there are no greater differences between them than will be found to exist in a comprehensive study of the continental population.

Another type of topographical race formation is the occurrence of partial populations distinctly deviating from the continental specimens, of species wide-spread in Asia but occurring in Malaysia in a single island.

*Pirola japonica* SIEB. is for example mainly distributed in Japan but is known in continental Asia from Manchuria and Korea. The race in Korea is a distinct subspecies, and ANDRES (20) considers the Malaysian entity, from N. Sumatra, to be a separate species: it is distinguished by the leaf shape, leaf colour, leaf size, and colour of the flowers. ANDRES accepts it as related to the 'Formenkreis' of *P. japonica*.

Many SE. Asiatic mountain plants are common to the Himalayan and Khasyan tracts as well as to Sumatra and Java; minor differences are often observed between the continental and the Malaysian specimens, but they are *not* connected by intermediates. This feature of topographical segregation did not deceive HOOKER, and his collaborators in their attempts to verify the identity of the Indian and Javan specimens and species.

Examples of racial differentiation in mountain plants could be cited by the dozen. The above-mentioned will suffice to illustrate their presence in the Malaysian flora.

This local differentiation is often a *crux botanicorum*. In genera like *Potentilla*, *Ranunculus*, *Gentiana*, *Euphrasia*, &c. every mountain massif has

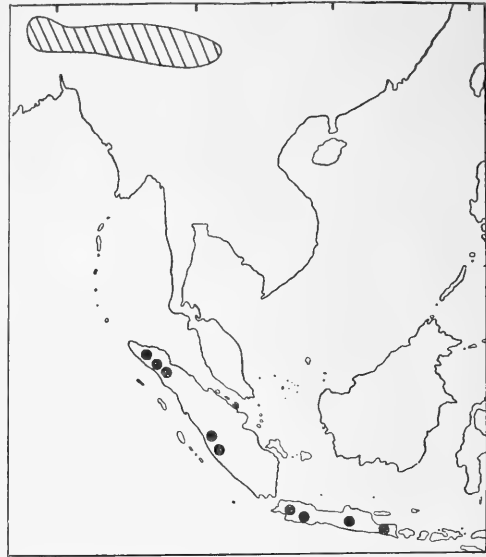


Fig. 38. Distribution of *Primula* sect. *Candelabra*; in Malaysia only one species.

its own type and intermediates are mostly not found. Each form must be carefully considered to define its rank. Monographic study is indispensable; local studies alone will not yield satisfactory results.

*Cited literature:* (1) A discussion of some of these problems is found in my study of Malaysian mountain plants, cf. Bull. Jard. Bot. Btzg III, 13 (1934) 141–146. (2) Bull. Jard. Bot. Btzg III, 17 (1948) 385. (3) Data after BACKER, Handboek Flora Java pt 3 (1924) 3. (4) BACKER, Handboek Flora Java pt 2 (1925) 33–34. (5) Bull. Jard. Bot. Btzg III, 11 (1931) 296. (6) Bull. Jard. Bot. Btzg III, 16 (1939) 10–7210. (7) Bull. Jard. Bot. Btzg III, 8 (1927) 146. (8) Blumea 2 (1936) 192. (9) Blumea 4 (1941) 359–481. (10) Monogr. (1934); Blumea 3 (1938) 74. (11) Blumea 1 (1935) 351–512. (12) Handboek Flora Java pt 3 (1924) 33; pt 2 (1928). (13) Journ. Fac. Sci. Hokkaido Imp. Univ. 3 (1935) 219–232. (14) Pfl. Reich Heft 102 (1937). (15) Journ. Arn. Arbor. 27 (1946) 442–452. (16) Bull. Jard. Bot. Btzg III, 17 (1941) 146. (17) De Trop. Natuur 19 (1930) 81–82. (18) A. ERNST, Ber. Schweiz. Bot. Ges. 48 (1938) 156–165. (139) Rec. Trav. Bot. Néerl. 36 (1939) 438, 445. (20) Bull. Jard. Bot. Btzg III, 14 (1936) 4–7. (21) Bull. Bot. Gard. Btzg, III, 18 (1949) 213–227.

## 6. The problem of speciation

A mass of literature exists on the origin of new species and the specific concept. It is outside the scope of this introduction to evaluate all the recent, and often brilliant, advances in this field of research. I have already commented on this in my study on the origin of the Malaysian mountain flora (1).

According to BATESON, DOLLO, DE VRIES, and LOTSY the discontinuity in the characters or complexes of characters of the organisms enables us to distinguish species. An *abrupt origin of new forms* is consequently suggested, i.e. mutation *sensu amplissimo*.

No objection is raised against the assumption of a gradual dynamic change and shift in units or populations after they have been (abruptly) established. This may be caused by dispersal into some new environment and, eventually by secular changes in conditions of growth.

The consequence of the principle of discontinuity and mutation principles is that *no aeons are necessary for the origin of new species; they may originate abruptly*.

This is exactly what has been found experimentally in recent decades. In the single source of speciation now known beyond any doubt, i.e. hybridization connected with a duplication of the genome, the abruptness of the process is demonstrated. Since 1912, when DISBY described the raising of the 'constant hybrid' *Primula kewensis* W. WATSON, a polyploid new species, numerous examples of this kind have been found. LOTSY predicted the hybrid origin of *Spartina townsendii* GROVES. Later, thoroughly investigated additional instances have been described in *Salix*, *Nicotiana*, *Solanum*, *Brassica*, *Rosa*, *Digitalis*, *Phleum*, *Triticum*, *Secale*, *Saxifraga*, *Aegilops*, &c. Classical examples were those of HERIBERT NILSSON who raised an artificial *Salix cinerea* L., and of MÜNTZING who succeeded in producing *Galeopsis tetrahit* L. artificially, both species being generally recognized in West European floras. KARPECHENKO even managed to breed a constant intergeneric polyploid between *Raphanus* and *Brassica*. The new polyploids breed true and are separated by a sterility barrier from the parent species.

The occurrence of numerous genera in nature showing polyploid series of species suggests that, at last, part of the veil concealing the origin of new species of plants has been lifted. The disintegration of these highly complex genomes may be found to be another source of new combinations and may perhaps explain the peculiar dysploid series of chromosome numbers found in genera like *Carex*.

Mutation *sensu strictissimo*—the abrupt change of single genes—has also been demonstrated, but in all cases described these changes are below specific rank.

The outcome is that new polyploid species can be produced in 2 generations, that is, in the case of herbs in a few years, in the case of trees in less than a century. No Lamarckian periods are needed for species formation, in contrast to the views held by some zoologists who often postulate a gradual

change of an entire population into a new species. The parent species thus disappears. In plants, the polyploid stands quite independently from the parent species; it has its own range of variability and its own ecological needs. It thrives independently of the parent species and there is no reason to expect a close competition between them. Balanced and unbalanced polyploids probably spring into existence and, subsequently, varying disintegration of the genome may take place.

It stands to reason that *polytopic* origin will be frequent, though it may escape actual observation and must be inferred. It might seem that such polytopy would throw plant geography into confusion, in particular as regards the explanation of disjunctions. This is, however, not the case because at the place and moment of the origin of a new species *both* parent species must have been present.

A test case for the actual occurrence of polytopy could be made out by *tracer*-characters e.g. between two specific populations A and B which are both racially differentiated into two races which may be indicated as A<sup>c</sup> and A<sup>d</sup>, and B<sup>x</sup> and B<sup>y</sup>, with the polyploid combinations A<sup>c</sup>B<sup>x</sup> and A<sup>d</sup>B<sup>y</sup>. If experimental taxonomy could analyse such a case, it would almost amount to a proof of a polytopic origin of the polyploid population consisting of the races A<sup>c</sup>B<sup>x</sup> and A<sup>d</sup>B<sup>y</sup>.

Additional possibilities are manifold. One parent species may become extinct, followed by isolation of the new species from the other parent; subsequent geological discontinuation of this isolation and the entrance of a new wave of pioneer or marginal elements of the generic population may or may not occur, and recombinations within the limits of the partial generic polymorphy in the area; then, also, geological change (*orogenesis*) may give an opportunity to formerly unviable combinations, &c. An unending vista of possibilities thus opens; much must be assumed and little can or will be proved by the laborious and painstaking methods of experimental taxonomy.

Few Malaysian plants have been studied cytologically, and little is known of the occurrence of polyploidy which must certainly exist in the large genera of the Malaysian flora. In these genera one often meets some species aberrant in size. My list of suspected records is unfortunately lost; from memory I quote *Anellema giganteum* R. BR., *Urtica grandidentata* MIQ., *Macaranga* sp. div., *Homalanthus giganteus* Z.M.

It must be added that, though the *origin* of new *taxa* will generally be sudden, the rate at which the new forms will multiply and spread under natural conditions from the place of origin may greatly vary, and range from nil to some unknown quantity. This will depend mainly on the ecological potentialities of the *taxon* (i.e. its capacities for adaptation, dispersal and tolerance) and the eventual accessibility of 'ecological niches'. Experience has convinced me that closely related species may show a widely different ecological behaviour. I am principally opposed, therefore, to WILLIS's contention that—among closely related species—the size of the area of distribution depends only or



mainly on 'age'. A close comparison and careful valuation of the distribution of species in *Nepenthes*, *Dolichandrone* and others in Malaysia show the untenability of the assumed universal application of 'age and area' when explaining origin in conjunction with distribution. WILLIS's is a mathematical, not a biological trend of thought.

*Cited literature:* (1) Bull. Jard. Bot. Btzg III, 13 (1935) 358-385, with list of literature.

### 7. The effect of isolation

Isolation has been accepted as an important source of the origin of new species. It was assumed that an isolated group of plants would evolve independently, in the course of long periods, diverging in appearance from the parent population.

These views are derived from the theories of LAMARCK, DARWIN, and WALLACE and still find followers among zoologists.

In the light of experimental botanical taxonomy, however, it appears, *firstly*, that acons are unnecessary for the origin of new forms below the rank of a species, and of species themselves: *a few generations are sufficient*; and *secondly* it is highly improbable that single isolated, genetically well balanced species will give rise to constant new *taxa*.

Several allied species, however, growing together in geographical isolation from the ancestral populations may produce combinations not realized in the original centre, because they represent only a portion of the potential polymorphy of the genus and, at the same time, are closely allied and isolated when breeding. The probability of new *taxa* is increased the nearer this 'isolated affinity' is to the margin of the area occupied by the parent population, this marginal population being always distinctly different from that in the centre. Here recessive characters become predominant. Such a local development of an 'isolated affinity' may constitute a secondary centre of speciation. If the isolation is geologically ancient, archaic characters will be preserved as the isolated population remains untouched by the effacing influences of the original centre of speciation. Local and exceptional factors of climate and soil, aided by selection, will determine the constitution and general aspect of the isolated populations.

To measure the period of isolation by the number of deviating species present in an isolated area (a lake, a summit, an island) seems an uncertain procedure, since experimental taxonomy shows that speciation itself is a rapid process. Judgment is highly subjective and the effects of geological and climatic changes and other accidental factors influencing the life of isolated populations cannot be accurately estimated; reference may be made to what was said on geographical segregation in the introduction.

The most important function of isolation is the *preservation of types, gene complexes and genom combinations*, which may become lost in the dynamics of the remainder of the population.

An excellent opportunity for the study of the

effects of isolation is furnished by Australia where many plants were introduced, intentionally or unintentionally, in former centuries. In the Queensland flora several species are mentioned which are otherwise known only from Europe, and many others only from Asia. The Queensland forms are sometimes described as separate species, e.g. *Trigonella suavissima* LINDL. According to BENTHAM, this is closely allied to some South European species, but not quite identical with any of them. The same is the case with *Lavatera plebeja* SIMS, *Glycirriza psoraleoides* BTH., *Zinnia australis* BAILEY (genus otherwise neotropical), *Erythraea australis* R. BR., *Lycium australe* F.V.M., *Datura leichhardtii* F.V. M., &c.

Others are identical, or nearly so, with widely remote populations, such as *Statice australis* SPRENG. (also recorded from E. Asia), *Alyssum linifolium* STEPH., *Gypsophila tubulosa* BOISS., *Saussurea carthamoides* BTH. None of these were collected at an early date and they are certainly not recent intruders. None has ever been found in Malaysia!

A closer study of this problem ought to comprise both herbarium and library work combined with field work and experiments. It may be that some of the above-mentioned species represent natural disjunct areas, but I find it extremely difficult to accept this for the majority.

### 8. Centres of speciation in the Malaysian flora

It is an established fact that the distribution of species within a generic area is mostly far from gradual and regular. Genera with a rich development of species specially show a specific differentiation in one or more centres radiating into neighbouring countries and become gradually or abruptly poorer towards the generic boundary. One could speak of the *decrease of the potential polymorphy of the genus* from the centre towards the boundary. *Isoflors* can be distinguished, that is, areas with the same number of species of one genus.

As a rule the outermost isoflor contains only one species which is generally also the most widely distributed. The natural explanation is to assume its emergence from the richer isoflors, i.e. from the centre of the genus.

(a) *The centre of speciation is situated outside Malaysia.* This is true of practically all microtherm plants (1), and is demonstrated e.g. by the genus *Primula* of which two species are recorded from Malaysia. One of these *P. sumatrana* MERR., is of uncertain affinity but approaches the type of *P. auricula* L., and is only found in the extreme north of Sumatra. The second species, *P. prolifera* WALL., belongs to sect. *Candelabra* which comprises some 25 spp. in SE. Asia, mainly in W. China. It occurs on the mountains of Sumatra and Java (fig. 38). The richest centre of specific and sectional development of the genus is SE. Asia (Himalaya-W. China).

The Malaysian species are obviously isolated outliers. The Malaysian localities are arranged



along a very definite line and this induced me to assume that the Malaysian species formerly migrated along a *migratory track* from the centre to reach their present stations at the limit of the generic area (1).

Similar examples are known in many other genera centered outside Malaysia, and I have therefore

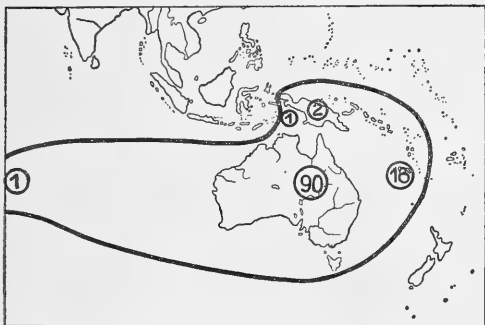


Fig. 39. Geographical distribution of the genus *Hibbertia* (Dill.), centre in Australia, one species in Madagascar.

concluded that at least 3 migratory tracks existed, the *Sumatran track*, the *Formosa-Luzon track* and the *New Guinea track*.

An example of a migrant along the Formosa-Luzon track is *Lilium*. This genus has 70 species in the N. hemisphere. Its subg. *Eulirion* sect. *Leucolirion* has 13 spp. in the Old World, to which the single Malaysian species *L. philippinense* BAKER from Formosa and Luzon belongs.

An example of a species following the New Guinea track is e.g. *Hibbertia* (Dill.), genus with ca 110 spp. of which 90 occur in Australia, 18 in New Caledonia, 1 in Madagascar, and 1 in New Guinea and Aroe Isl. The last is closely allied to one of the Queensland-New South Wales species (fig. 39).

The past history of the area and specific development in the genera *Primula*, *Lilium*, and *Hibbertia* are not known with certainty. Nevertheless judging from the present distribution, it seems clear that the marginal species are outliers spreading from the centre of specific development in each genus. Sometimes more than one species occupies the boundary area.

(b) *Genera with one centre of specific differentiation outside and another inside Malaysia.* Among Asiatic genera there are few examples of clearly marked centres. The number of Indian and Malaysian species belonging to such genera often gradually changes in various directions within the generic area as a whole. A remarkable case of several separate centres is *Rhododendron*, which has its richest centre in Himalaya-W. China with secondary centres in Borneo and New Guinea. Though exact figures are not known there is certainly *no gradual decrease* in the number of species from SE. Asia towards New Guinea. *Rubus*, *Poten-*

*tilla*, and *Gentiana* also have secondary centres in New Guinea.

Among plants with SE. affinities several good examples may be mentioned: *Trachymene* which contains appr. 20 spp. in Australia, 1 in New Caledonia, 1 in Fiji, 10 in New Guinea, 1 in the Moluccas, 1 in the Lesser Sunda Islands, 6 in Celebes, 1 in the Philippines and 1 in Br. N. Borneo. The orchid genus *Corybas*, with a rich centre in New Guinea is another striking instance (fig. 40).

A still more widely distributed genus is *Drimys* which extends from Mexico to Tierra del Fuego, and further to New Zealand, Australia, New Caledonia, New Guinea, the Moluccas, Celebes, Philippines, and Borneo. It has a separate centre in the S. Pacific and another in New Guinea.

A typical case of abrupt centres of specific development is *Euphrasia*, a microtherm genus almost confined to the N. hemisphere but with a distinct track across the Sunda bridge via Australia to New Zealand and Juan Fernandez, Tierra del Fuego, and Chile. From Borneo, Celebes, the Philippines and Moluccas only one species or subspecies is recorded, but in New Guinea a number of species occur in a secondary centre; a third is found in New Zealand (fig. 41).

*It is difficult to see how these disrupt isoflora, and the formation of secondary centres could be caused otherwise than by past changes in the geography of the region concerned.*

The only method of tracing the origin of new species of which factual proof is available is through hybridization combined with polyploidy. This demands that at least two species be present for the formation of new ones. If part of the generic area, e.g. New Guinea, is cut off from contact with the main centre of the population for a long period, some combinations which are not preserved in the main centre may maintain themselves. If at a later period another migration wave is made possible through geological changes, a further portion of the potential polymorphy may at length penetrate into the area and so take part in renewed speciation. This opens the possibility of new com-

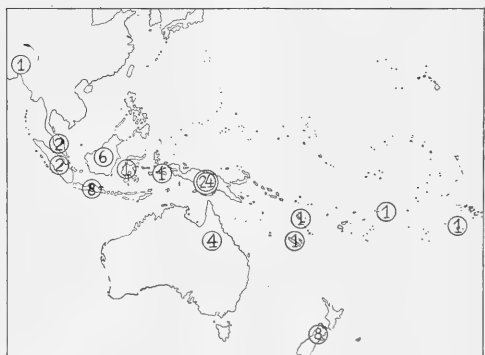


Fig. 40. Area of distribution of the genus *Corybas* (*Corysanthes*) (Orchid.). Centre in New Guinea, two secondary centres in W. Malaysia and New Zealand.

binations never realized in the original centre. The outcome might be the origin of a new secondary centre of speciation.

In the light of these hypothetical considerations the existence of secondary centres must indicate a complicated geological history of the area.

Similar pictures could be drawn for genera like *Dimorphanthera*, *Haplolobus*, *Xanthomyrtus* (fig. 43) *Palmeria*, &c., which centre in New Guinea and radiate into the Philippines, Celebes, and in some cases even into Borneo.

The richness of the centres in Malaysia is not

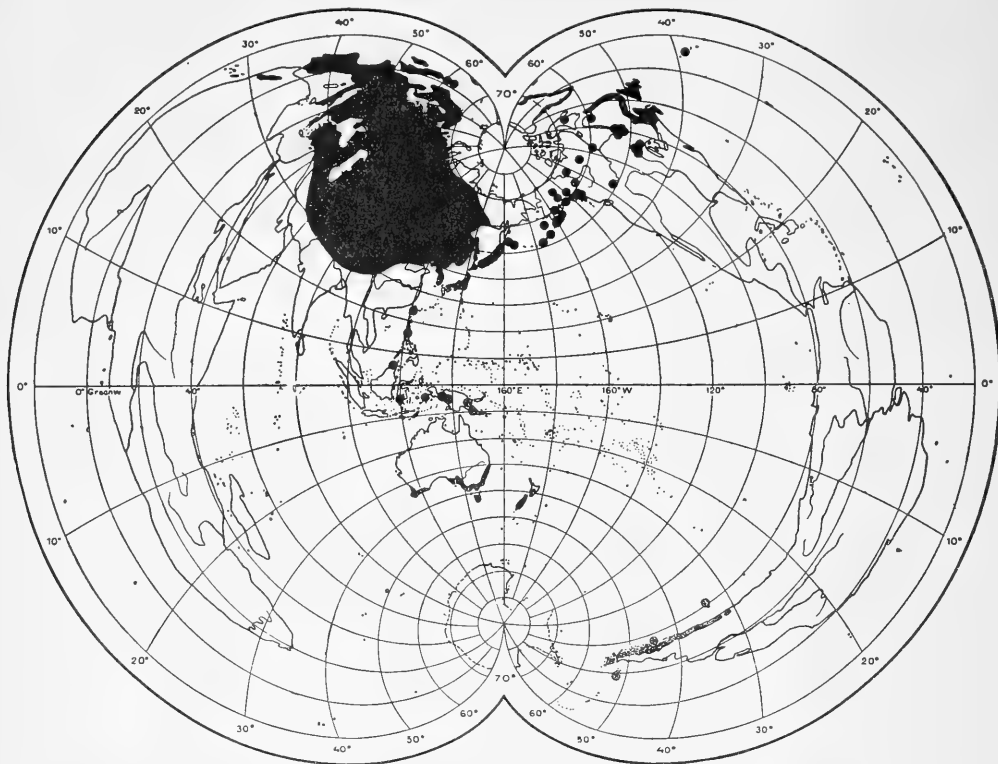


Fig. 41. Distribution of the genus *Euphrasia* L. (*Scroph.*). (after DU RIETZ, 1940)

(c) *Genera with a single centre of specific development in Malaysia.* An obvious example is the genus *Sericolea* (*Elaeocarpaceae*), with at least 17 spp., confined to New Guinea. A more advanced stage is seen in genera which have spread from their centre into other parts of Malaysia e.g. the genus *Archidendron* (*Leguminosae*) (2) (fig. 42). It is closely allied to *Pithecellobium* but differs in several flower and fruit characters, and shows the ancient condition of having more than one ovary.<sup>1</sup> The islands adjacent to New Guinea all have distinct species except for that of the Aru Islands which is also found on the main land.

(1) I wish to draw attention to the occurrence of essentially the same aberrant character in *Zoelleria*, a *Boraginaceae* from New Guinea. *Zoelleria* was even proposed as the type of a separate tribe on account of its several carpels, but according to JOHNSTON's opinion it is merely a remarkable pleiocarpous species of *Trigonotis*.

accurately known, the figures depending on the judgment of the monographer; most genera have not been recently revised. Though it is a common experience that when revisions are made many local endemics appear to be better reduced, it may be said that rich centres of specific development are situated in the West Malaysian province, specially Borneo, the Malay Peninsula, and the Philippines, and to a lesser extent in Sumatra. These centres, however, are mostly rich in the same genera and are better regarded as a single large centre.

The South Malaysian province (Java and the Lesser Sunda Islands) on the contrary, is exceedingly poor in centres of specific development, and does not represent a composite centre at all. New Guinea, in the East Malaysian province, appears to be a rich centre of the same rank as the whole West Malaysian province while the Moluccas and Celebes are poor and their vegetation mainly derivative.

Especially on the old continental shelf areas

specific development reaches its climax. This seems in contradiction to an almost generally accepted rule that a high percentage of specific endemism is typical of a young development. I refrain from commenting on this point, so as to avoid premature guess work.

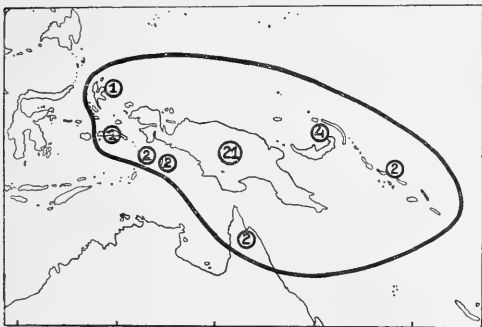


Fig. 42. Geographical distribution of the genus *Archidendron* (Leg.). Centre in New Guinea, with radiations into the adjacent regions.

The case of *Dryobalanops* may serve as a warning against drawing hasty conclusions. This is one of the well developed genera of dipterocarps in the West Malaysian province. The genus consists of 7 species found in a coherent area in Central Sumatra, the Malay Peninsula, and Borneo (fig. 44). There are no floristic or geographical characters to indicate that this genus is ancient, and its position among the genera *Shorea*, *Dipterocarpus*, *Vatica*, &c. which are far more differentiated is not isolated. Now, finds of fossil wood show that in the Tertiary *Dryobalanops* was abundant in South Sumatra and West Java. At present, therefore, it occupies a relic area.

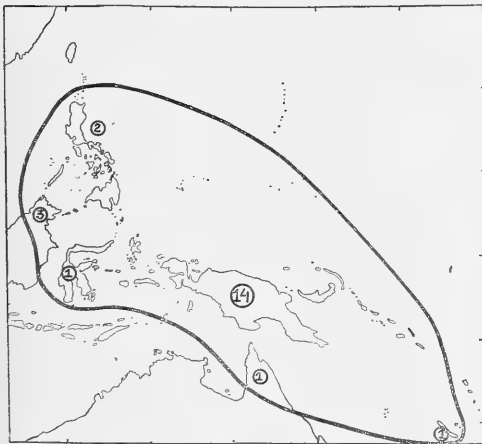


Fig. 43. Geographical distribution of the genus *Xanthomyrtus* (Myrt.). Centre in New Guinea, with radiations into the surrounding regions.

Most probably the centres of specific development are mixed, containing both progressive and relic species. To judge from the affinities, New Guinea harbours many old types belonging to a great number of families.

If the abundance of local endemics, so-called 'swarms', indicates a young flora, all tropical floras being very rich, must be young. I am not prepared to accept this assumption which implies that temperate floras are all of great antiquity.

It is sometimes assumed that rich specific development runs parallel with great diversity of habitat, varied topography and geology, and a variety of climatic conditions. Dr G. L. STEBBINS Jr alluded to this relation during the AAAS-meetings at Boston (Dec. 1946). The wet lowland forests of West Malaysia, on the other hand, show an intense speciation in e.g. *Dipterocarpaceae*, *Myristicaceae*, *Ebenaceae*, *Calamus*, *Canarium*, &c. although the environment has been extremely monotonous and uniform from an early period. Variability and

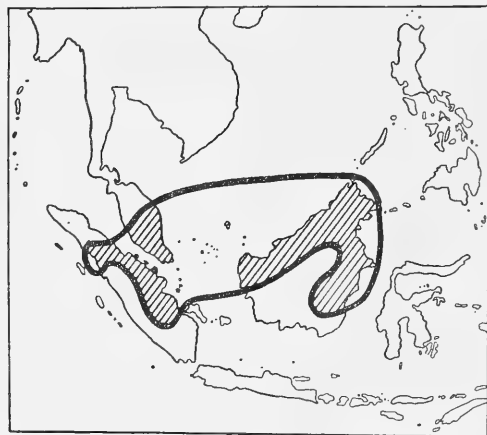


Fig. 44. Present area (shaded) of the genus *Dryobalanops* (Dipt.). Fossil records in S. Sumatra and W. Java.

change of environment are certainly not the only factors responsible for speciation.

Cited literature: (1) Bull. Jard. Bot. Btzg III, 13 (1934) 146. (2) De Wit, Bull. Jard. Bot. Btzg III, 17 (1942) 256-271.

#### 9. Centres of generic development in Malaysia

The centres of generic development show a similar picture as the centres of speciation; some notes will be given here.

In 1944, a survey of genera restricted to one island or island group resulted in the accompanying map (fig. 45). It appears that New Guinea is richest of all, and of the same rank as the total of the Sunda Islands and the Malay Peninsula together. Java, the Lesser Sunda Islands, Celebes, and the Moluccas prove to be poor. The estimates given in this map are generous because several

imperfectly known genera are included in the low figures. Sumatra in relation to its large surface is also rather poor in endemic genera. Borneo was possibly much richer in endemic genera formerly than it is now. During the Pleistocene Ice Age when the Sunda Islands were connected by dry land a number of endemic genera may have migrated out of Borneo and are now no longer endemics.

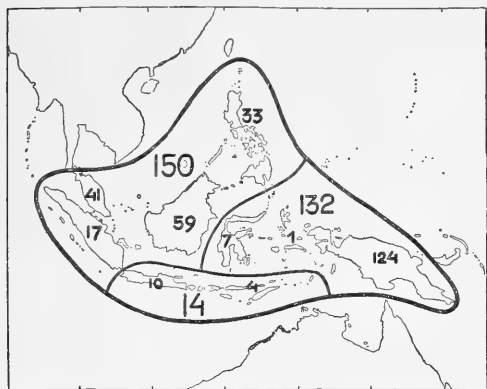


Fig. 45. Number of endemic genera of Phanerogams in the several islands and island groups of Malaysia, according to a census made in 1944.

Again the continental (shelf) areas, the Sunda Islands and Malay Peninsula in West Malaysia, and New Guinea in East Malaysia, are richest.

The figures must not be taken too strictly since they are not final and the revisions in the Flora Malesiana will effect changes in details. Moreover, no distinction is made between taxonomically very important genera (e.g. *Scyphostegia* in Borneo and *Papuzilla* in New Guinea) and those separated from large genera for convenience which represent merely derivative segregates.

#### 10. Local-endemic species and genera

To a botanist experienced in tropical field work, records of strictly local-endemic species seem absurd. Nobody who ever looks down from a summit on a vast tract covered by luxuriant tropical forest untrodden by a collecting botanist, can escape the thought that it is impossible to comb this welter of vegetation. In my experience novelties and new records are usual on every trip. Most mountains are climbed along one or, at best, very few trails, and even these frequented bridle paths continue to yield new finds and records at any time.

It is therefore scientifically inadmissible to discuss tropical local-endemic species.

A local-endemic species is one which has hitherto been found only in one single spot or island seems the only justified definition.

Botanists who have worked in the tropics are well aware of this but those acquainted only with the temperate vegetation seldom realize the true state of affairs.

In a tropical forest it is hardly possible to locate specimens of lianas, epiphytes and tall trees. Among all three classes some species are common and others are rare. To locate the rare or less common ones is impossible over more than a very limited area as for this purpose the vegetation must be cut down. How can one search for rare plants over hundreds of thousand square kilometres of forest vegetation?

Sometimes it is supposed that the flora of Java is completely known but, though Java is better known than any other large island in Malaysia, our knowledge is far from complete. Only a few years ago my colleague Dr BLOEMBERGEN was introduced to forest exploration work by a trained forester. In an area chosen at random in West Java for practice they found a large tree which proved to be a new species of *Vatica*. Only a single tree could be located. Another example is that of *Sophora wightii* BAKER discovered by JUNGHUHN a century ago in a mountain forest of West Java which is often assumed to be completely known. The small but conspicuous treelet has only been found once again. Of *Symplocos henschelii* (MOR.) BTH. from the same type of forest, also a small-sized conspicuous tree, in a century of botanical exploration in Java less than 10 individual trees have been located. Above Tjibodas, the mountain botanic garden in West Java, there are a few trees of *Ormosia incerta* KOORD. a 'local-endemic', which never flowered in 15 years. The monotypic Javan genus *Tetradlea* R. BR. was once collected by HORSFIELD, and a century later one other tree was located in East Java. These are only random examples from a well-explored area. In the rich centres of development mentioned in the foregoing paragraphs the progress of collecting is a *fortiori* much slower.

The same holds still more true of the exact delimitation of the geographical distribution of species, even in Java. Owing to the habit of always keeping to the beaten track a small swamp in the Tjibodas Forest Reserve was never explored though lying only a few metres from the path below the well-known Tjibeureum waterfalls. When searched, *Xyris* and *Juncus* were found to grow there in profusion, both new records for this part of West Java (1). Until 1930 *Primula prolifera* WALL., a very conspicuous plant, was known in Java only from Mt Gedeh in West and Mt Jang, in East Java. A few years later two intermediate localities were detected, both by tips of amateur botanists. On Mt Papandajan, I could readily locate some dozens of species at that time known only from Central or East Java and, in addition, made some new records for the flora of Java (2).

Another source of error due to so-called endemic species adds to the urgency of compiling the present flora. Hosts of species have been ascribed to a single locality but reappear under different names in various other places in or outside Malaysia although they belong to the same, widely scattered population. This refers especially to the floras of the Malay Peninsula, the Philippines, and New Guinea, which have been studied without con-

sidering the whole Malaysian material. In revisions local-endemic species usually vanish by the dozen.

In the light of such facts it seems impossible to use data on tropical local-endemics in support of far-fetched and sometimes highly hypothetical speculations concerning basic problems of the origin and distribution of species (*cf.* Dr WILLIS's theory of 'Age and Area'). Reliable objective data on the exact distribution of tropical species suitable for highly specialized scientific analysis are not available; they are certainly not precise enough to serve as the foundation of theories depending on the accuracy of the details.

*Cited literature:* (1) De Trop. Natuur 30 (1941) 170-172. (2) De Trop. Natuur 19 (1930) 73-91; *ibid.* 21 (1932) 101-108.

### 11. Parallel or homologous variation

Parallelism is the phenomenon that similar characters, or combinations of such, occur in otherwise

different plants or plant groups of the same rank. The characters vary from modificational to structural importance. Parallelism is most conspicuous when it occurs in closely allied species or genera in the same geographical area.



Fig. 47. *Discocalyx dissecta* KAN. & HAT. (Myrs.) from New Guinea, mossy forest, 1900 m,  $\times 2/3$ .



Fig. 46. Malaysian rheophytes: stenophyllous foliage as a common morphological 'adaptation' in systematically remote plants. a. *Nephrodium stenophyllum* BAKER (Polypod.), b. *Ardisia tahananica* K. & G. (Myrs.), c. *Ophioglossum inconspicuum* V.A.V.R. (Ophiogl.), d. *Boerlagiodendron borneense* (SEEM.) MERR. (Aral.), e. *Homonoia riparia* LOUR. (Euph.), f. *Neonauclea chalmersii* (F.V.M.) MERR. (Rub.), g. *Aglaia ijzermannii* BOERL. & KOORD. (Meliac.). All  $\times 1/4$ , except d,  $\times 1/6$ .

*Rheophytes* are plants restricted to riverbeds within the reach of swiftly running water (1). They have several characters in common among which the most prominent are stream-lined leaves approaching the *Salix*-type, a strongly developed root system, and mostly a sympodial branching resulting in a flat-topped habit. BECCARI called them *stenophyllous plants*. Species of genera with pinnate leaves tend to have simple leaves under these conditions. These stenophyllous plants belong to about 80 different families and to a still larger number of genera. In several large genera more than one species of this habit is known *e.g.* *Ficus*, *Syzygium*, *Neonauclea*, *Aglaia*, &c. (fig. 46).

In many mountain plants the leaves are roundish with a cordate, pseudo-amplexicaulous base, prominent nervation, and a coriaceous texture (*Ericaceae*, *Guttiferae*, *Symplocaceae*, *Myrtaceae*, &c.). It is surprising to observe these features in Bornean *Ericaceae*: *Rhododendron*, *Costera*, *Diplycosia*, *Vaccinium*; this proves it not to be limited to mountain species, and that these features are not simply 'adaptive'.

In New Guinea a peculiar series of plants occurs belonging to families which characteristically have simple leaves; here the leaves are pinnatifid. The genera *Ardisia*, *Discocalyx*, *Begonia*, *Cyrtandra*, *Elatostema* are examples; in most genera more than one species shows similarly incised leaves. Why this convergent development should occur preferably in Papuan plants remains obscure (fig. 47).

In Bornean plants I believe to have traced a remarkable series of species in the most diverse families all possessing a peculiar long brown indumentum. These plants occur both in shady forests

and on light mountain slopes. The hairiness recurs in a large number of plant groups of very remote systematic position.

The same can be observed in other morphological characters, e.g. *cauliflory*, *flagelliflory*, *geocarp*, the *cycadoid habit*, *exceedingly large leaves*, the *presence of tubers*, and the *occurrence of exceedingly long caudate-acuminate leaf-tips* ('Träufelspitze'), *macrobiocarp*, and *microphyllous dwarf species*. The last are particularly abundant among New Guinean mountain plants.

NAUDIN (2) drew attention to numerous cases of parallel variation in the *Cucurbitaceae* and DUVAL-JOUVE (3) mentioned instances in the *grasses*, and in *Juncus*.

DARWIN (4) termed such variation *analogous* or *parallel variation*; he observed it often in different races of one species, more rarely in descendants of remotely allied species.

HUGO DE VRIES (5) regarded the results of parallel variations as derived true varieties, and contrasted them with the elementary species (Jordantons) which he considers as of quite different rank.

VAVILOV (6) in an essay on what he calls 'the law of homologous series in variation' gave a large body of new examples in the *grasses*, *cucurbits* and *leguminous plants*. He assumes that each family has a 'cycle' or 'series' of variability present in all its genera.

VAVILOV's idea was that these genera have an inner stable hereditary set of '*radicals*' governing the major structural characters. Besides, numberless other factors act in varying ways, but more superficially (like slight variations in embroidery on a basic underlying pattern). *Radicals* and *variable characters* (specific complexes of morphological and physiological nature) would thus be essentially different.

In a most interesting study of the 90 known genera of the *Annonaceae* DIELS (7) opposed the views of DE VRIES and VAVILOV. He found that the characters used to separate genera are not '*radicals*' but that each genus is characterized by a complex of '*varying characters*'. If, in the *Annonaceae*, concluded DIELS, one wishes to speak of radicals, then there is only one radical; the family character (structure). He pointed to the fact that VAVILOV himself shows some uncertainty when attempting to trace a sharp distinction between radicals and varying characters. He also opposed VAVILOV's thesis that only radicals are important in taxonomy and phylogeny and that therefore the systematics of the *Cruciferae* is wholly at fault (being based on varying characters) in contrast to the *Ranunculaceae* where the genera are separated on structural differences. DIELS pointed out that these families cannot be compared and contends that the degree of sharpness in demarcation depends on the absence or presence of intermediate homologous variants, or, possibly on our ignorance of the existence of such '*links*'. For the *Annonaceae* DIELS tabulated the following characters: 1. aestivation; 2. dimery against trimery; 3. perianth partly connate or free; 4. anthers locellate or not; 5. distribution of the sexes (polygamous, monoecious,

dioecious); 6. insertion of the flowers (on leafy twigs, or cauliflorous to flagelliflorous). Each genus is in this way represented by a certain formula. It appears that very few possible combinations are not realized in nature; some exist but have only recently been collected, e.g. *Mezzettiopsis*, in 1912, in Borneo, with formula P || O<sub>1</sub>. Hence very few are extinct. The present 'completeness' and 'prosperity' of this pantropical family in the recent flora is a highly interesting phenomenon as it is generally believed to be of ancient ancestry. The formula Ka Pr O  $\infty$  ascribed to the theoretical ancestor of the *Annonaceae* is still shown by several genera distributed over the whole of the tropics. Parallel variation causes a reticulate structure of affinities. From an evolutionary point of view one generally assumes a 'pluripotent ancestor'.

Genom complexes (HAYATA) (8), or 'Artengene' of HERIBERT NILSSON (9) seem to be more or less independent and may be combined into different formulas. HAYATA is therefore probably right in assuming so-called analogies to be not essentially different from homologies.

*Cited literature:* (1) Bull. Jard. Bot. Btzg III, 12 (1932) 196–201. (2) Ann. Sci. Nat. IV, vols 6, 7, 12, 16. (3) Bull. Soc. Bot. France 12 (1865) 196–211. (4) Variation, 1 (1868) 442–458; 2 (1888) 340–345 (2nd Engl. ed.). (5) Die Mutationstheorie 1 (1901) 454. (6) Journ. Heredity 12 (1922) 75. (7) Sitz. Ber. Preuss. Akad. Wiss. 1932, Math. Phys. Kl. p. 77–85, specially p. 81. (8) Icon. Plant. Formos. 10 (1921) 76–234. (9) Lunds Univ. Årsskr. N. F. Avd. 2, 27 (1930) 3–4.

## 12. Reticulate affinities

Reticulate affinities occur chiefly in moderately large to large genera of plants. Normally a large group of allied species is intimately interrelated and shows different combinations of a relatively limited number of more or less equally important characters. Reticulate relationship makes a natural classification very difficult and is unsuitable for a linear arrangement. A division of the group into sections and subsections is hardly possible.

According to DANSER *Nepenthes* is a case in point; the species are often closely allied to one another, division into subgenera or sections is impossible (1), but the genus itself is a most natural unit.

A similar state of affairs is found in large groups of the genera *Begonia*, *Ficus*, *Vaccinioideae*, *Rhododendron*, *Syzygium*, *Symplocos s.str.*, *Saurauia*, and others, all showing an abundant development of species in Malaysia.

Reticulate affinities probably indicate 'fully expressed' potentialities.

It is not certain, of course, that all potentialities in every plant group are viable, and may have existed or will exist, or will exist at the same time. Gaps may persist by inner genetic necessity.

I am not prepared to answer the question whether this must be considered to be a 'young' or an 'old' feature. The development itself has probably been accomplished rapidly. Its preservation has pro-

bably depended on the dynamics of disturbing environmental factors. Damp tropical hothouse conditions are more apt to preserve uncommon combinations than any other environment, and organisms with poor prospects of survival may find an ecological niche here and survive.

*Cited literature:* (1) Bull. Jard. Bot. Btzg III, 9 (1928) 403.

### 13. *Vicariism in the Malaysian flora*

Vicariism is the phenomenon that two species which are *inter se* distinctly closer related than to any other member of their group, replace one another with exclusion of their area geographically or altitudinally. Vicariism occurs both in the lowlands and the mountains, and between lowland and mountain plants.

Whether one should speak of subspecific segregation or of racial differentiation in delimiting such species is sometimes merely a matter of taste. In the latter case geographical exclusion is necessarily present. Therefore, it seems preferable to apply the term 'vicariads' only to *taxa* which are by general consent lineeonts.

Typical cases of vicariism are found in mangroves. VAN SLOOTEN (1) has demonstrated that the two allied species of *Lumnitzera* exclude each other almost consistently. A similar case of exclusion is found in the genus *Camptostemon* between *C. philippinensis* (VIDAL) BECC. and *C. schultzei* MAST. (2).

Still more remarkable behaviour is shown by *Aegialitis*. The two species in this genus are both restricted to the mangrove, one occurring from Bengal to Mergui and the other in East Malaysia and Queensland (fig. 48).

In *Gossampinus* two species occur in Java, viz *G. malabarica* (DC.) ALST. and *G. valetonii* (HOCHR.) BAKH. which exclude each other, *G. malabarica* preferring the semi-arid central and eastern regions, *G. valetonii* being confined to the everwet western parts. In Central Java few inter-

mediate specimens have been found and are assumed to be hybrids.

Vicariism also occurs in mountain plants; a few examples may demonstrate this. *Gynura aurantiaca* (BL.) DC. occurs in Java from Mt Gedeh eastward to Mt Wilis between 850 and 2400 m, the species replacing it in East Java is *G. densiflora* MIQ. which is found from Mt Lawoe eastwards, between 2200 and 2800 m (3).

A similar replacement is found in *Anaphalis*. *A. javanica* SCH. BIP. occurs in West to Central Java and *A. viscida* DC. replaces it in East Java (4) and North Central Java.

Closely allied species, but never found close together, are *Polygala pulchra* HASSK. and *P. venenosa* (BL.) JUSS., the first is practically confined to ridges and summits, the latter to the forest borders and gently sloping forest; they possess the same size and habit.

In *Agathis*, DANSER distinguishes 3 Malaysian species viz *A. borneensis* WARB. in the Malay Peninsula, Sumatra, and Borneo, *A. alba* (LAMK.) FOXW. in the Philippines, Celebes, and Moluccas, and *A. labillardieri* WARB. in New Guinea and adjacent islands. Each of these three allied species excludes the others from its area of distribution but they all occupy the same place in the vegetation.

Typical cases of altitudinal vicariism are also known. Two species of *Sopubia* occur in Malaysia, *S. stricta* DON in SE. Asia also occurring in Madoera Island (E. Java), in lowland grassfields. *S. trifida* HAM. is a mountain plant known from Africa through trop. Asia and Malaysia to Australia. In Malaysia its altitudinal range is 950–1800 m. In Java it is found in one place, due S of Madoera Island on Mt Idjen, also in grassfields, at 1000 m.

In *Orchidaceae*: *Bulbophyllum tenellum* LINDL. occurs in Java between 1000 and 1500 m, but according to J.J. SMITH its closest ally, *B. xylocarpit* J.J.S., is confined to mangrove forests. Both are epiphytes.

In Java and the Lesser Sunda Islands two native species of *Casuarina* occur, the first, *C. equisetifolia* L., confined to the coastal regions or the beach and the second, *C. junghuhniana* MIQ. (= *C. montana* MIQ.), occurring exclusively in the mountains and, although its lower limit descends from W to E, the two species never occur mixed.

In Timor and adjacent islands at least two species of *Eucalyptus* occur: the white-stemmed *Euc. alba* REINW. in the lowlands and the dark-stemmed *Euc. cf. platyphylla* F.V.M. (an *Eucalyptus decaisneana* BL.) in the mountains. Occasionally populations adjoin but they are never found mixed.

Similar cases are known in the genus *Styphelia*, of which allied species occur in the lowland and the mountains.

The Javan *Lonicera*s have already been mentioned in the paragraph on altitudinal racial differentiation. *L. acuminata* WALL. and *L. javanica* (BL.) DC. occupy corresponding places in the mountain forest but their areas do not overlap altitudinally (fig. 35).

How vicariads would behave if they would not be separated is a very interesting question both

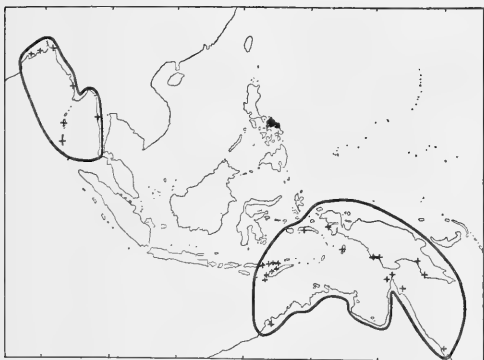


Fig. 48. Geographical distribution of the genus *Aegialites* (Plumb.). The Asiatic species *Aeg. rotundifolia* (PR.) ROXB., the Australian-East Malaysian *Aeg. annulata* R. BR.

from the taxonomical and the phytogeographical point of view. In some cases SAX (5) found a high degree of fertility (*Platanus*, *Campsis*, *Larix*) between geographically remote species. Recently E. C. SMITH proved in *Catalpa*, that in species which have been isolated during a considerable period a complete interspecific fertility may have been preserved (6). It is not clear what the aspect of the population would become when these species would be in close contact.

*Cited literature:* (1) Bull. Jard. Bot. Btzg III, 6 (1924) 44; De Trop. Natuur 11 (1922) 51, 65. (2) TROLL, Flora 128 (1933) 348-360. (3) BACKER, Rec. Trav. Bot. Néerl. 36 (1939) 451-455. (4) Bull. Jard. Bot. Btzg III, 13 (1934) 184-185. (5) Journ. Arn. Arbor. 14 (1933) 274-278, *ibid.* 13 (1932) 368. (6) Journ. Arn. Arbor. 22 (1941) 219-221.

#### 14. *Adaptation and migration*

The concept *adaptation* is closely interwoven with that of 'natural selection' which causes it to be often misunderstood. On the other hand it ought not to be discarded; after all, plants are adapted to the place where they grow. They are able to tolerate the limiting factors of their particular station because they possess certain genom structures which provide the individuals during their development with physiological and morphological characters enabling them to grow and propagate.

Adaptation is not an innate purposeful change, and selection is a merciless agent directed by the environment, unyielding in its basic demands for adjustment to its minimum factors. The plant is left no way out, it has to comply or to perish on the spot. Each plant is, therefore, of necessity adapted to its habitat, that is: in accordance with the local minimum factors indispensable for its survival and propagation.

The only 'active' principles of the plant as a passive object are the genetic dynamism of the population which produces new combinations, partly viable partly lethal, and also its population 'pressure' leading to dispersal resulting in migration.

The phrase that plants 'have adapted' themselves, then, means that the population has managed to produce combinations capable of meeting the minimum claims of the environment.

*Adaptation is therefore selection based on tolerance*, a general principle affecting every plant species, and every vegetation type (1).

A species migrating into a semi-arid savannah area burned yearly must possess properties to withstand this savannah environment. It must either be able to sprout from a rootstock, a bulb or a tuber, or its stem must be corky, its seeds must be able to germinate in the open and withstand fire, its root system must be able to get water even during a long dry period, &c. These demands are also met by ephemerals which complete their life cycle within the short period of the rainy season.

Forests also offer a special environment; its

species must be able to germinate, flower, and fruit in the shade. Similarly in case of mountains, swamps, solfatara, &c.

This harmony between plant and *monde ambiante*, as an implied result of the tolerance of plants under the selective agency of the environment is, to a certain extent, reflected in the biological spectra of RAUNKIAER. It is essentially the same as R. D'O. GOOD's 'Principle of Tolerance', and the general conception of natural selection by DARWIN. The environment is thus partly directive.

These considerations, however, do not exclude the possibility that plants possess characters which have no relation with the demands of the environment. Indeed most structural characters are unaffected by the environment e.g. the type of inflorescence, the phyllotaxis, the number and attachment of ovules, whether the ovary is superior or inferior, whether the stamens are diplostemonous or obdiplostemonous, the habit arboreous or herbaceous, &c. The plant will thrive if, within its range of tolerance, it can adjust itself to the conditions of life in its environment, if not it will inevitably perish.

The harmony between plant and habitat does not imply that the nature of the habitat of a plant can be deduced from its appearance. Physiology apparently admits diverse means of adjustment. We find, e.g. in the microphyllous stunted forest of the Papuan Alps large-leaved species of *Schefflera* and *Olearia* at 4000 m altitude, and equally hygrophilous large-leaved species of *Alpinia*, *Cyrtandra*, and *Saurauia* at 3000 m altitude on the summits of Celebes. In Java at the same altitude we find with the dominant microphyllous *Vaccinium*, *Leptospermum*, and *Rapanea* trees, typical hygrophytes as *Neillia thyrsoiflora* DON, *Prenanthes rostrata* BL., and mesophyllous large-leaved *Photinia notoniana* WALL.

We should be wrong to infer the habitat of *Taxotrophis*, which sometimes dominates the undergrowth of everwet Malaysian forests, from its morphology; the very hard thorny leaves would suggest it to be a species of semi-arid thorny jungle.

Hairiness is also no indication whatever of habitat. S. KURZ (2) already commented on this with regard to *Semecarpus* of the Nicobar islands. He says: "This tendency to become pubescent is peculiar to a great number of tropical trees, and is not attributable, as some may suggest, to a drier or sunny station, but seems to be rather idiosyncrasy. For we often find the two states growing side by side in the densest shade of the tropical forests. This is the case, e.g. with *Micromelum pubescens*, while the perfectly glabrous and the almost villous-pubescent form... of *Vangueria spinosa* grow similarly associated in the dry hot forests of Prome. Other examples of the same phenomenon are afforded by *Garuga pinnata* and *G. mollis*, *Chickrassia tabularis* and *Ch. velutina*, *Schrebera swietenia* and *Schr. pubescens*, *Holarhena codaga* and *H. antidysenterica*, *Trewia nudiflora* and the glabrous form, *Berrya ammonilla* and *B. mollis*, *Grewia laevigata* and its pubescent form,



*Walsura trijuga* and *W. pubescens*, *Amoora rohituka* and *A. aphanomyxis*, *Terminalia catappa* and its pubescent form, and numerous others. In two only of these, viz in *Berrya* and *Micromelum*, have I observed real intermediate and therefore connecting states. In most of these cases not only are the vegetative parts affected but the calyx and the corolla also." Another typical case from Java may be added. *Dodonaea viscosa* JACQ. occurs behind the beach in a glabrous form and on the mountains between 1100 and 3300 m in a hairy form!

A consistently microphyllous type of vegetation is found on the sandy padang soils of Banka, dominated by *Baeckea frutescens* L., *Eugenia banksiensis* (HASSK.) BACKER, *Styphelia malayana* (JACK) J.J.S. and *Leptospermum flavescens* J.Sm. The leaves of these plants are typical of micro-sclerophyllous scrub of xerophilous habitat. The habitat is in fact *everwet tropical lowland*, suitable for coconut and pepper.

One of the wildest theories I ever met in literature was proposed by the geographer W. Volz. He supposed that during the Upper Pliocene there was an arid climate in North Sumatra (3), basing, or mainly sustaining, this theory on the statement that the present vegetation of *Pinus merkusii* JUNGH. & DE VR., *Saccharum spontaneum* L., *Imperata cylindrica* P.B., *Pteridium aquilinum* KUHN, and a spiny 'Acacia' consists of relics from an arid period, these being 'xerophilous' plants. This absurdity needs no further comment here; it is a layman's fancy when, in the field on a hot sunny day, trying to understand narrow leaves.

These examples show the uncertainty of deducing a climate from the morphology and size of leaves only. This is important especially in palaeontology, particularly because in general only the thicker leaf types will be preserved.

Adaptation, then, exists but in the restricted sense discussed above. Its manifestation is quite different from what is often popularly described and illustrated by picked cases. Life apparently has many means to meet the demands of the environment.

*Migration* is not a purposed but a passive dynamic process affecting all plants. Each plant tends to (not intends to) expand its area from the mere fact that seeds or spores are produced and disseminated by each generation in various ways and through various agencies. If conditions in the area are uniform this extension will be circular, as a fungus spreads on an agar plate.

In nature the expansion will be modified by the surrounding barriers e.g. a mountain plant on an elongated range will 'follow' the range. Such  $\pm$  linear radiations have been found to exist in Malaysia. I have named them 'tracks', along which plants wandered, dissemination being the only impulse for progress.

If the environment becomes active—changes abruptly or secularly, which certainly happens continually—plants are driven from their original sites. With the change in the environment, the demands change. Suppose that in some region a secular change of the climate towards more arid

conditions takes place. This desiccation will cause the gradual multiplication of the most drought-resistant combinations, and there is much shifting. It is conceivable that these drought-adapted combinations had formerly no chance of survival under moist conditions and always perished *in situ*. Under the new conditions they have a chance of survival and a new species or subspecies is created. Other species which could just survive earlier moist conditions, and occurred in small numbers in the driest stations, multiply gradually at the cost of those species which were at their optimum under the moist conditions. Species unable to produce arid-tolerant races will become exceedingly rare, or disappear entirely. Thus the whole community is affected by the shift due to climatic change.

Another kind of change in the environment is orogenesis (mountain formation); this has played an important role in the composition of the Malaysian plant communities. The environment will now select hardy types because temperature tolerance is most important in plants. Orogenesis opens the possibility of the origin of new combinations either of specific or infra-specific rank. The facts support this view: many typically tropical genera and families mainly developed in the tropical lowlands have shown ability to produce mountain species (*Pandanus*, *Macaranga*, *Albizia*, *Casearia*, &c.).

Conversely, typically microtherm genera have produced species able to thrive in the tropical lowland (*Corybas*, *Ajuga*, *Lysimachia*, *Salix*, *Salvia*, *Rosa*, *Ulmus*, *Clematis*, &c.).

The abrasion of Malaysian mountains by rapid tropical erosion causes, in addition, a gradual shifting of the mountain vegetation from cool zones to the subtropical and tropical climates (4). This is not mere hypothesis, it has actually occurred on large massifs now demolished or reduced to medium height. In particular, this process is still going on in the Malay Peninsula and the islands in the S. China Sea which have been subjected to erosion for a geologically very long period. Some mountain plants kept their ground on the summits at exceptionally low altitude, e.g. *Oreobolus kukenthalii* STEEN. which grows, in the Malay Peninsula, at much lower altitudes than in Sumatra. Together with some other plants I believe it to be representative of a formerly much richer relic flora which is now largely extinct.

*Adaptation and migration are inseparable, their mechanism is always bound to a passive selection by the environment.*

The size and variation of the area of distribution of a species or a genus is thus undoubtedly dependent on geography and topography (presence of barriers) and the capability of its genetic potentialities to produce combinations able to meet the demands of the very different environments nature throws in its path.

The 'why' and the origin of these potentialities are an aspect of the genom chemistry, which has today hardly reached the stage of research, and is still beyond our knowledge.

A survey of the size and development of the different natural plant groups as a manifestation of the capacities of the genome shows that some groups are of small size but occupy a considerable area, others have a large area and hundreds of species, still others demonstrate a huge development in a comparatively small region, and this leads one to suppose that development is to some extent illogical and not subject to strict causality.

Nature is nevertheless causal and causality governs the chemical and physical background of the genome structures.

As far as I can see the taxonomy of chemical compounds corresponds to a certain extent with biological taxonomy. Some compounds are stable, others unstable, some are widely spread, others are local, some elements have developed into a highly divergent pattern (like carbon) comparable to tribes and highly differentiated orders, others abstain from developing into families, some elements have still unlimited potentialities, of others the potentialities are rigidly restricted.

The comparison goes further: reticulate affinities and linear affinities are present in chemistry as well as in biology. The compounds known to us, or presented in nature remain, in number and structure, far below the conceivable ones, and are subject to natural selection. Chemical taxonomy presents only that set of compounds which is in agreement with the environment offered by our globe. Other parts of the universe presenting other environments open the possibility for other chemical combinations. The chemist endeavours to create artificial environments favourable to the development of compounds not manifested in nature, like a biologist creating *Primula kewensis*. Hollow curves, which WILLIS (5) considered so important are equally valid for biological and chemical taxonomy, and are based essentially on the structure of the natural system of chemistry, that is, homologous with it. It would seem worth while to work out the 'ancestral tree' of chemical compounds.

*Cited literature:* (1) Tectona 30 (1937) 639. (2) Journ. Asiat. Soc. Beng. new ser., pt II, 45 (1876) 126. (3) Die Gajoländer (1912) 97, 191, 291–292. (4) Bull. Jard. Bot. Btzg III, 13 (1935) 300; and also KLASTERSKY, Preslia 6 (1928) 25–30. (5) 'Age and Area' (1922) 195; 'The Course of Evolution' (1940) 33.

### 15. Hybrids in the Malaysian flora

Few natural hybrids have been recorded from the Malaysian region partly because of the primitive stage of research on the subject. The few facts which have come to my knowledge I will enumerate here.

One of the first records in the Indo-Malaysian region is a hybrid between *Blumea bifoliata* DC. and *B. lacera* DC. by S. KURZ (1) who found this 'undoubted' hybrid in Calcutta.

In the middle of the last century, VEITCH's collector, THOMAS LOBB, and Sir HUGH LOW accumulated a wealth of material of Malaysian *Rho-*

*dodendron*, in the Malay Peninsula, Sumatra, and Borneo, for cultivation. Among the species concerned were *Rh. brookeanum*, *javanicum*, *malayanum*, *jasminiflorum*, and others. From these VEITCH succeeded in raising for ornamental purposes numerous hybrids with fertile progeny (2).

WIGMAN (2) apparently made some artificial hybrids of *Passiflora* species in the Botanic Gardens, Buitenzorg, but did not write a full report.

Several Malaysian species of *Nepenthes* are used in raising hybrids for ornamental purposes, and apparently some of these hybrids are also found in nature. According to DANSER (3) no scientific records are extant on progeny and fertility of the hybrids. The difficulties in specific delimitation in this genus are certainly partly due to natural hybridization.

In *Gramineae* quite a number of hybrids are recorded or supposed to occur in nature. BACKER (4), in his work on the Javan grasses, repeatedly refers to intermediate forms supposed to be hybrids. Hybridization in grasses is not limited to members of the tribes, inter-tribal hybrids being known as well. Some results of the extensive experiments with grasses made at the Sugar Experiment Station, Pasoeroean, Java, were published by RÜMKE (37). He experimented with hybrids of *Saccharum* × *Erianthus*. The notes on most trials were deliberately destroyed when the station was burned down in 1947, much to the loss of science.

In *Juncus*, BACKER recognized a plant from Java (5) which he assumes to represent a natural hybrid between *J. glaucus* EHRH. and *J. effusus* L. It should be noted that on the mountains where this hybrid was collected, one of the parents (*J. glaucus*) is absent.

BACKER (36) mentioned the occurrence of an intermediate form in *Glinus* in places where *Gl. lotoides* L. and *Gl. oppositifolius* (L.) DC. grow together; he assumes this to be of hybrid nature.

*Parkia intermedia* HASSK. is a species described from Java. According to BACKER (6) there are two forms. The first he believed to be a hybrid between *P. roxburghii* DON (= *P. javanica* (LAMK.) MERR.) and *P. speciosa* HASSK. The other he suspects to be a hybrid between *P. intermedia* HASSK. and *P. speciosa* HASSK. He added in a note, that according to trustworthy native information *P. javanica* and *P. intermedia* would very often develop from the seeds of *P. speciosa*. Moreover, *P. intermedia* is never planted as such, but always develops from seeds of *P. speciosa*. Though it could be easily assumed that cross-fertilization through bats occurs, genetic research is needed to settle the status of these forms.

Of *Gossampinus* two species are well-known in Java, viz *G. malabarica* (DC.) ALST. with dark-red flowers and *G. valetonii* (HOCHR.) BAKH. with pale or greenish-yellow flowers. In distribution these two species exclude each other; they are vicariads, *G. malabarica* preferring the semi-arid regions, *G. valetonii* being confined to the parts which are wet throughout the year. Both occur throughout Java, as the climatic zones form an intricate mosaic of local climates. In Central Java specimens have

been collected with nearly orange to orange flowers and other intermediate characters. Mr BAKHUIZEN VAN DEN BRINK Sr suggested that these specimens represent hybrids (7).

In Timor at least two species of *Eucalyptus* occur, viz the white-stemmed *hoeë*: *Euc. alba* REINW. in the lowlands, and the darkstemmed *angopoe*: *Euc. cf. platyphylla* F.v.M. (an *Euc. decasneana* BL.) in the mountains. Dr BLOEMBERGEN (8) made a special search into the interior for eucalypts and found, in a locality where both parents were present, some trees intermediate, both in bark and other characters. As hybrid swarms of eucalypts are common and well-known in Australia, the assumption of the occurrence of hybrids in Timor is very likely to prove correct.

In *Polygonum* DANSER (9) originally located only one natural hybrid in Malaysia, viz between *P. barbatum* L. and *P. pulchrum* BL., which he recorded from Siam, the Malay Peninsula, West Java, and Kangean. It is entirely sterile. In the W. Java locality *P. pulchrum* was present, but the other parent was absent!

Later he found (10) two other *Polygonum* hybrids, and also some in *Rumex*. The first was cultivated in the Botanic Gardens, Buitenzorg; he interpreted it as *P. runcinatum* D.DON  $\times$  *P. chinense* L. Flowering was abundant but fruit never formed, pollen developed poorly.

The other hybrid was between *P. orientale* L. and *P. pulchrum* BL. and was found in great quantity in some swamps in Central Java. The plant had the habit of *P. pulchrum* which was also present in the locality, but the other parent *P. orientale* was absent. The hybrid is entirely sterile.

In *Stachytarpheta*, a genus of *Verbenaceae* native in the New World, some natural hybrids have been found in Java and elsewhere in Malaysia. DANSER who described (11) the hybrids also succeeded in making artificially combinations not seen in nature. Four out of 6 possible combinations had been found wild. All hybrids were intermediate and sterile. One of them did not flower for a long time but, some years after DANSER had left Buitenzorg, I noted that this plant was flowering.

In his works on Malaysian *Orchidaceae* J. J. SMITH occasionally referred to hybrid orchids but to my knowledge he never gave a summary of his observations. He made a hybrid *Spathoglottis* (12) and described a hybrid *Vanda* (13) from Alor Island, an artificial hybrid *Coelogyne pandurata* LINDL.  $\times$  *asperata* LINDL. (14) as well as the natural hybrids *Calanthe ceciliae* RCHB. f.  $\times$  *C. veratrifolia* R.Br. in Java, and *C. speciosa* LINDL.  $\times$  *C. pulchra* LINDL. (15).

Mr R. E. HOLTUM paid much attention to hybrid orchids and made extensive observations in the Singapore Botanic Gardens. He wrote a large number of papers on his experiments from about 1930 onwards. Several important remarks in these studies (16-21) attack the very basis of the generic and specific concepts in orchidology.

In the first place it seems beyond doubt that numerous native species are of hybrid origin, e.g.

*Arachnis maingayi* RCHB. f. = *A. flos-aeris* RCHB. f.  $\times$  *hookeriana* RCHB. f., *Dendrobium superbiens* RCHB. f. = *D. bigibbum* LINDL.  $\times$  *veratrifolia* LINDL. (or some other combinations of sections *Phalaenanthe* and *Ceratobium*), while *Dendrobium fleischeri* J.J.S. is *D. phalaenopsis* FITZG.  $\times$  *d'albertisii* RCHB. f.

Further natural and artificial hybrids are known in the genera *Cymbidium*, *Paphiopedilum*, *Renanthera* (22), *Phalaenopsis*, &c.

Intergeneric hybrids are also known (23), and species of *Vanda* (incl. *Euanthe*, *Vandopsis*, &c.), *Phalaenopsis*, *Arachnis*, and *Renanthera* are in most cases freely inter-fertile which stresses their close relationship. Records of the distinctive features of the hybrids produced by such inter-generic crosses may help to throw light on the mutual relationships of the genera and on their true status. The fact that the lip characters of *Renanthera* are, in hybrids, almost entirely dominant in the  $F_1$  is of interest. Now that so many bi-generic hybrids in this group are being raised in the eastern tropics, we may expect a good deal of further information of this nature, which systematists might well study and consider.

Some orchid hybrids are sterile in the  $F_2$ , and several flower seldom. The  $F_1$  is mostly intermediate. Hybridization has, most probably, played a very important role in the speciation of *Orchidaceae*, and this may explain a good deal of their boundless development in Malaysia and some other tropical countries. It would be an intricate task to disentangle the relations. It is certain, however, that numerous described species will appear to be of hybrid origin.

A similar view could be held about *Rhododendron*, already referred to above. Nevertheless in Java, as far as I know, the 7 species and one variety are sharply distinct and no natural hybrids have been recorded. Other islands carrying a profuse development of the genus (Sumatra, Borneo, and New Guinea) have a different record.

In 1932, Dr C. HEUSSER collected much material of *Rh. longiflorum* LINDL. in Samosir peninsula, Lake Toba (N. Sumatra), at ca 900 m. He also found a gregarious *Rhododendron* scrub near solfatara in the same place where plants varied in the colour of the flower and shape of the leaves. Dr J. J. SMITH described them (24) together as *R. longiflorum* LINDL. var. *heusseri* J. J. S. The variety is, however, far from uniform and the collector hints at the possibility of a hybrid progeny.

The same species, *Rh. longiflorum* LINDL. has also been used in artificial crosses, as was reported by Mr R. E. HOLTUM (25-26) who began to cross *Rhododendron* experimentally at Singapore.

I am convinced that hybridization had an important creative function in the specific development of the genus in Malaysia. The practical work needed for a real understanding of the specific relations here will require laborious experiments with native species from remote regions, the cultivation of which will present serious difficulties in itself.

Also in *Diplycosia* (*Ericaceae*) reticulate affini-

ties suggest the possibility of a hybrid origin of species, which are known to occur elsewhere in the family in *Vaccinium*, *Gaultheria*, &c.

A speciality of the Malaysian vegetation is the possibility of hybrid native trees. In the *Dipterocarpaceae* with its swarms of species in *Dipterocarpus*, *Shorea*, &c. hybridization has been reported in the genus *Dipterocarpus* from the Philippines (27), Thailand (28), Burma (29–30) and the Malay Peninsula (31–32).

SYMINGTON (33) says that the so-called hybrid plants have characters intermediate between those of well-known species. In Burma PARKINSON reports that "small pockets or patches of these hybrid plants sometimes occur intermixed with the parent types where, with little trouble, specimens showing a whole range of characters from one species to another could possibly be collected. These plants are even recognized as being of hybrid nature by village Burmans. It appears that most of the species of the genus, if not all, hybridize naturally."

According to SYMINGTON, a similar statement could not be made for Malaya, but he does not claim to have given the problem much attention. He says that it is possible that some of the intermediate collections will turn out to be clearly defined species that have escaped the collectors because of chance and their comparative scarcity e.g. *D. kunstleri* KING, which was at one time suspected of being a hybrid (34).

The opinion of so highly experienced a specialist is of course important but it does not exclude the possible hybrid origin of plants now recognized as good species.

Many hybrids are known among Malaysian ornamental plants, e.g. in *Hibiscus*, *Canna*, *Lantana*, *Bougainvillea*, &c. and also in economic plants and crops, e.g. *Ceiba*, *Citrus*, *Mangifera*, *Oryza*, *Hevea*, *Thea*, *Solanum*, *Eugenia*, &c. (35).

Important observations were made by Dr H. J. TOXOPEUS who succeeded in making a hybrid between the genera *Gossampinus* and *Ceiba*, and also between several different genera in *Rutaceae*. In the latter family, the generic concept is taxonomically far from stable and convincing.

A most interesting fact, found by VILLERTS (1937), is that species of *Begonia* from almost all sections could be intercrossed.

In conclusion I want to express the opinion that, though few facts are known, it is likely that hybridization has played a far greater part in speciation than would appear from the present scanty data.

There are wide opportunities for research—unfortunately in Malaysia mostly on slow-reproducing arboreal plants—involving field work as well as herbarium studies.

It is almost certain that from large genera like *Syzygium*, *Ficus*, *Begonia*, *Cyrtandra*, *Ardisia*, *Rhododendron*, &c. some basic knowledge about speciation can be obtained.

*Cited literature:* (1) Journ. Bot. 5 (1867) 376. (2) Referates of HENSLOW's reports by WIGMAN, *Teysmannia* 2 (1891) 397, 466, 713; 3 (1892) 517; and *Gartenflora* 1892. See also BURBIDGE, Culti-

vated plants (1877) 93. (3) Bull. Jard. Bot. Btzig III, 9 (1928) 274, 299, 324, 353, 363, 374, 403. (4) Handboek Flora Java, pt 2 (1928) 23–289. (5) Handboek Flora Java pt 3 (1924) 44. (6) Schoolflora v. Java (1911) 425. (7) Bull. Jard. Bot. Btzig III, 6 (1924) 242–243. (8) *Tectona* 33 (1940) 121–122. (9) Bull. Jard. Bot. Btzig III, 8 (1927) 198. (10) Bull. Jard. Bot. Btzig III, 12 (1932) 65. (11) Ann. Jard. Bot. Btzig 40 (1929) 1–43. (12) *Teysmannia* 31 (1920) 102–105. (13) Gard. Bull. Str. Settl. 5 (1931) 222. (14) *Teysmannia* 21 (1910) 342. (15) *Die Orchideen von Java* (1905) 205. (16) with C. E. CARR, Notes on hybridization of Orchids, *Mal. Orchid Rev.* 1 (1932) 13. (17) Hybrid Orchids in the Singapore Bot. Garden. *Mal. Orch. Rev.* 2 (1934) 25–27. (18) The Scorpion Orchids. *Mal. Orch. Rev.* 2 (1935) 64. (19) Orchid hybrids in Malaya, M. A. H. A. Mag. 10 (1940) 41–46. (20) Some hybrid Orchids, natural and artificial. Bull. Jard. Bot. Btzig III, 16 (1939) 113–115. (21) Notes on the progress of hybrids in the Bot. Gardens, Singapore, *Mal. Orch. Rev.* 2 (1935) 64. (22) New hybrids raised at Singapore. *Mal. Orch. Rev.* 2 (1936) 100–109. (23) Hybrids in the genera *Arachnis* and *Renanthera*, *Blumea*, Suppl. 1 (1937) 52–56. (24) Bull. Jard. Bot. Btzig III, 13 (1935) 447–448. (25) M. A. H. A. Mag. 9 (1939) 34. (26) M. A. H. A. Mag. 11 (1941) 93. (27) FOX-WORTHY, Phil. Journ. Sci. 6 (1911) Bot. 250. (28) KERR, Journ. Siam. Soc. 2 (1914) 9. (29) PARKER, Ind. For. Rec. 13 (1927) 11, 24. (30) PARKINSON, Burma For. Bull. no 27 (1932) 31. (31) FOX-WORTHY, Malay For. Rec. no 10 (1932) 58. (32) SYMINGTON, Malay For. 7 (1938) 35. (33) Mal. For. Rec. no 16 (1943) 159. (34) PARKER, Ind. For. Rec. 16 (1930) 7. (35) cf. HOLTUM, M. A. H. A. Mag. 11 (1941) 22–29. (36) Onkruidfl. Jav. Suiker (1930) 240. (37) *Saccharum-Erianthus* bastaarden. Wageningen, 1934, 64 pp. ill. (thesis).

## 16. Polyembryony, parthenogenesis and apogamy

Polyembryony in Malaysian plants was described more than a century ago by REINWARDT (1) in *Mangifera*. It is often found in cultivated plants and was later, from Malaysia, described by H. J. TOXOPEUS in *Citrus*, by L. VAN DER PIJL in *Eugenia*, and by HILLE RIS LAMBERS in *Coffea*. In *Rutaceae* it seems to occur in several genera e.g. in *Murraya paniculata* JACK (2) and *Zanthoxylum*. The embryos are produced from different parts of the ovule.

There is little doubt that many bad specific distinctions in various genera, notably in the *Rutaceae*, in *Eugenia*, &c. are due to the occurrence of polyembryonic propagation which, again, is probably preceded by hybridization. Here is certainly yet another field for the experimental taxonomist promising results to both pure and applied science.

Parthenogenesis and apogamy have proved to be of high importance to phytography in Europe, specially when interpreting the microspecies described in certain genera which have always offered difficulties to the systematic botanist; e.g. *Hieracium*, *Taraxacum*, *Alchemilla*, *Rubus*, *Rosa*, *Crataegus*, &c. Intrinsic factors form a barrier here

against the formation of intermediates, and the plants propagate pseudo-sexually in pure lines or clones. In Malaysia such apomictic forms have been mostly described from cultivated plants but recently Dr H. J. TOXOPEUS when investigating the native genus *Derris* cytogenetically found them in wild species.

Certainly these phenomena exert great influence in other very large and difficult genera with great numbers of badly defined species like *Ficus* and *Syzygium* (of which over 150 species have been described from Borneo alone).

I am convinced that the taxonomy of several of our large genera e.g. *Smilax*, *Dioscorea*, *Medinilla*, *Psychotria*, *Saurauia*, *Ardisia*, and *Ophiorrhiza* is unsound, and that this unsatisfactory state of affairs has certainly a natural cause. In the group *Moluccani* of the genus *Rubus* scores of specimen-descriptions were made which stimulated other authors to publish some more (3).

In this connection BACKER made some valuable remarks on *Rubus* (4) *Smilax* (5), and *Dioscorea* (5, p. 116). The natural explanation is clearly not—as in the microspecies of *Pavetta* and *Ixora* described by BREMEKAMP—to be based on racial differentiation since the forms do not exclude each other geographically or ecologically. I suspect here the occurrence of natural intrinsic 'abnormalities' in sexual reproduction and genom behaviour.

*Cited literature:* (1) Flora 8<sup>2</sup> (1825) 427; Nova Acta vol. 12; Isis (1829) 391. (2) Current Science 3 (1935) 361 (3) Compare MASTERS, in *Passiflora foetida* L. (1894). (4) Schoolflora voor Java (1911) 450. (5) Handboek Flora Java, pt 3 (1924) 76.

#### 17. The origin of native aliens in Malaysia

In one of the foregoing paragraphs I referred to several genera of the New World represented in Malaysia by species behaving as aliens (*Rumex obovatus* DANSER, *Kosteletzkya batacensis* (BLCO) F.-VILL., *Elephantopus scaber* L.).

The native Malaysian flora has also produced many species only known from secondary vegetation types or areas under anthropogenous influence. Most 'weed trees' of the secondary forest (1) belonging to the *Euphorbiaceae*, *Ulmaceae*, *Urticaceae*, and the like, are not known as components of the primary forest. They are *botanical nomads*.

*Where did these plants grow before mankind cleared the forests?*

I have suggested (2) that:

- (a) Some are derived from forest plants which can grow in open habitats.
- (b) Some were present in the original vegetation in a few special ecological niches then negligible in number of individuals if compared with their abundance and common occurrence today.
- (c) Some have probably been produced after the forests were cleared by man.

(a) Numerous instances indicate that true forest trees may possess qualities enabling them to grow in open habitats. *Schima noronhai* REINW. is rarely a predominating tree in the forest but in artifi-

cially cleared places it gets its chance and forms extensive pure secondary growths, e.g. in South Sumatra, Banka and Borneo. In the open, juvenile individuals often flower and fruit. The same is observed in *Adinandra*, *Calophyllum*, &c.

BRASS has collected, in New Guinea, a new species of *Parasponia* which in the forest grows into tall trees but on land slides is a small shrub. Cases like these point to unknown capacities of forest trees (see also p. x, xxxviii).

Some forest trees withstand fire in the seedling stage, a capacity they do not require in the primary forest, and which most forest trees lack. These species have multiplied abundantly in the open, man-made spaces where agriculture, hunting and cattle are predominant and fire is a common occurrence.

(b) A considerable number of species occupied special 'ecological niches' in the original vegetation resembling the open man-made places where they subsequently multiplied on an enormous scale (2-4). *Pinus merkusii* JUNGH. & DE VR. is a tree in the primary forest but its natural habitat is limited to steep ridges, land-slides, hot springs, mud wells, limestone cliffs, rocky places, and the new 'soil' of volcanic mud streams ('lahars'). Seeds and seedlings need sunshine or high temperature both for germination and growth. Once past this stage they grow to their largest size in the dense primary forest as emergent trees which serve as seed parents. The number and areas of these ecological niches were originally small, and so the number of *Pinus* individuals in nature was at first comparatively small. When the Gajo people some 3000 or more years ago cleared the forests on an increasing scale to work fields and raise cattle, and fired the vegetation for hunting and clearing purposes, the deforested lands more or less represented the conditions of the small niches where seed parents were present. *Pinus* then 'followed' man as a pioneer plant and it multiplied fantastically as it could survive the fires to a certain extent. This is the origin of the pure Sumatran pine forests of the present time. The same story could be told of *Eucalyptus* in the Lesser Sunda Islands, the East Javan mountain 'tjemara' (*Casuarina junghuhniana* MIQ.), of *Melaleuca* in Boeroe Island and New Guinea, of teak (*Tectona grandis* L. f.) in Java, and of many others which behave in the same way. Most of these cases occurred in a climate with a slight to severe dry season each year.

Another example of an ecological niche is found under everwet conditions. Various *Euphorbiaceae*, *Ulmaceae*, *Urticaceae*, *Moraceae*, &c. grow always in single-storied secondary growth and thickets. In the primary forest one does not meet them in the normal stands and canopies but only in open spots, especially where large trees have been felled by lightning or wind, bringing down in their fall neighbouring trees with which they were entangled by lianas. These open spots, the 'eyes' of the forest, are rapidly filled by seedlings of the 'weed trees'. The native people often call them 'toetoep' (*toetoep* = to close). They cover the gaps rapidly and start

a local sere but in the end they disappear and are replaced by forest trees which germinate in their shadow and after some years choke them. In this way the forest heals its own wounds.

More permanent natural open spots, comparable to these temporary ecological niches occur elsewhere: e.g. areas in which rivers have changed their course, margins of forests along lakes and rivers, land-slides in ravines, open ground near solfatara, deposits of volcanic sand and volcanic mud streams, lava streams, extinct volcanic cones, and slopes where heavy winds have torn down the forest.

The principle of the great increase in numbers of pioneer plants all over the world since man cleared the vegetation holds, of course, for the fauna as well. I predicted (5) that the grassfield subspecies of birds which E. MAYR (6) recorded from the grassfields near Lake Sentani in North New Guinea do not indicate a much larger former extension of these fields in New Guinea, but that it is likely that these bird-races in smaller numbers had their original home in 'natural secondary growth and grassland'. I am satisfied that Mr A. L. RAND, during the Archbold Expedition, found this to be the case (7).

(c) Probably several species have come into being after the clearing of the primary Malaysian forests by man. Their genetic combinations were not viable in the dense dark primary forest and originally perished at once. With the shift of the environment towards local savannah conditions other circumstances, favourable to the new combinations which needed light and heat for their ontogenic development prevailed. I should not be surprised if such coarse weed-trees as *Homalanthus giganteus* Z.M., *Macaranga tanarius* M.A., *Endospermum formicarum* Becc., &c. were polyploids and derived from allied small-leaved forest species.

I have previously made the same suggestion (8) regarding the origin of a number of desert plants. Deserts offer exceptional opportunities to species otherwise ecologically not viable. Here again is an almost untouched field of research for experimental taxonomy. These considerations apply to trees as well as to shrubs and herbs.

*Cited literature:* (1) Short-lived rapid growing trees like *Macaranga*, *Cecropia*, and *Trema*. (2) *Tectona* 30 (1937) 641. (3) Tijdschr. Kon. Ned. Aardr. Gen. 52 (1935) 51, 188-189. (4) Verslag 28e Vergad. Proefst. Pers. (1941) 195-204, specially p. 202-203. (5) Tijdschr. Kon. Ned. Aardr. Gen. 52 (1935) 62-63. (6) Novit. Zool. 36 (1930) 25. (7) Bull. Amer. Mus. Nat. Hist. 68 (1935) 534, 556, 557; *ibid.* 77 (1940) 377; Amer. Mus. Novit. no 1122 (1941) 1, 3; Bull. Amer. Mus. Nat. Hist. 79 (1942) 284-285. (8) *Tectona* 30 (1937) 645-649.

### 18. The origin of Malaysian cultigens

Plants known only in the cultivated state (*cultigens*) are equally common in temperate and tropical regions. From prehistoric times man has tried in Malaysia as well as in Europe, to select, breed, keep, and improve all plants useful to his daily

needs or desirable from an aesthetic point of view. The tropical flora is so varied and abundant that the number and the variety of cultigens in the tropics are relatively larger than in the temperate regions. A remarkable character of the Malaysian tropical flora is that only very few staple foods are genuinely native (5); the majority of species important as producers of starch and oil for the Indonesian diet have been introduced less than a thousand years ago, and the greater part is even from post-Columbian time. The introduction of many cultigens of minor importance, however, took place in a pre-Columbian period and now these are spread from Africa to India and Malaysia, including West Polynesia.

These domesticated forms are sometimes racial or varietal groups which only differ from the native ancestor in small characters (e.g. variegated leaves) or also may be of subspecific, specific or even generic rank. This latter category includes e.g. *Tamarindus indica* L., and, according to some palmologists, *Cocos nucifera* L.

No intergradation is observed as a rule between cultigen and wild ancestor and this discontinuity might be connected with their abrupt mode of origin, i.e. mutation in the wider meaning.

After DE CANDOLLE's stimulating work 'Origine des plantes cultivées etc.', the development of genetics, and of cytogenetics, added to an explanation of the mode of origin of the cultigens.

Cultigens are to some extent comparable to the pioneer plants which were treated in the foregoing chapter; both owe their position to the activity of man, i.e. cultigens intentionally, pioneers settling in or near inhabited areas unintentionally. Together they may be termed *anthropogens*.

The activity of man in developing a cultigen from a wild species can be divided into three stages, firstly *preservation*, secondly *breeding*, thirdly *selection*. Most cultigens have passed through these stages; some, however, still remain in the first phase and others in the second.

*Preservation, the first stage*, is to pick from the native flora specimens with special deviating qualities, with rare or desirable virtues, and to transplant them. These picked specimens naturally consisted often of one single or a few specimens from one locality. These exceptional individuals were grown and spread intentionally by man, and multiplied so greatly under anthropogenic conditions as never would happen in nature. Such plants usually possess a number of (genetically) recessive characters which make them feeble competitors. In nature these forms soon disappear for this reason and merge into the specific population by crossing, except when they happen to find a special 'ecological niche' where they are enabled to maintain themselves. Man in a primitive state has saved i.e. kept for domestic or other purposes, many of these comparatively feeble plants and so prevented their disappearance. Forms with spotted, coloured, or variegated leaves, dwarfs, monstrosities<sup>1</sup> or aberrant specimens with desirable charac-

(1) *Celosia cristata* L. is one example from many.

ters, and also sterile hybrids, &c. are thus handed down to posterity. A beautiful instance of a 'preserved' plant in the first stage, is the Chinese *Ginkgo biloba* L. although it is said to have been detected recently in a natural vegetation type.

The second stage (breeding) requires a higher stage of civilization; permanent fields and settlements, i.e. a developing agriculture are indispensable. The cultigen spreads from one village or family to another, and so becomes common property.

The transition to the third stage (selection) is gradual. Aberrant or deviating individuals which now originate among the cultivated plants (secondary varieties) are again picked. These plants differ from those picked in the first stage in that they do not occur in nature. These plants are cultigens in *optima forma*.

Both the range of variation and the number of forms in the first and third stages depend on the genetic variability (polymorphy, genom potentialities) of the species as a whole, the stability of its genom, and the strength of eventual fertility barriers between this and other species. Some species have very few potentialities and so have been hardly improved in comparison to their ancestors, e.g. buckwheat. Other species are remarkably polymorphous, e.g. *Cocos nucifera* L., *Nephelium lappaceum* L., &c. Interspecific sterility seems hardly to exist in some families, such as *Rutaceae*, *Orchidaceae*, *Begoniaceae*.

Many cultigens are propagated vegetatively only, either because it is desired to keep them 'pure', or because they bear no fruit, or produce only flowers of one of the sexes, e.g. some species of fragrant *Pandanus* which are either sterile or bear only ♂ spadices. Some species of *Mangifera*, *Eugenia*, *Citrus*, &c. are propagated by seeds but these are poly-embryonic and in fact vegetative (apogamous).

It has been asserted that herbs, on account of their rapid reproduction (shorter life cycle) if compared with trees, would have produced relatively more cultigens than trees. However, the Malaysian flora, being predominantly arboreous, has yielded arboreous cultigens by the dozen (see table below).

The origin of cultigens can be traced partly by means of morphological comparison with the wild flora, and the most nearly allied species are generally regarded as their 'ancestor'.

Recent genetic experiments have been found useful in determining the probable ancestors.

It appears that many cultigens possess multiple or aberrant chromosome numbers, being dysploids or polyploids owing to their origin by hybridization or mutation.

The difficulties in tracing the origin and native country of several plants now commonly cultivated rest on four points.

(a) The combined results of field botany, floristics, and taxonomy, indicate that it is sometimes practically impossible to fix with certainty the origin and native country of cultigens if their allied species occur over wide areas. The method of determining the degree of kinship fails altogether to produce a good proof in such cases.

(b) Natural rejuvenation is often no conclusive proof, this occurs commonly specially in anthropogenic vegetation communities e.g. near human dwellings, also in savannahs and grassy lands, other kinds of open vegetation, and in aquatic communities.

*Tamarindus indica* L. forms almost pure stands in the Lesser Sunda Islands and also savannah-like vegetation types. Natural rejuvenation is observed but probably occurs also in the African savannahs.

The 'acclimatization' of alien plants is generally much overrated, although the open vegetation types have many exotic species in their plant communities.

Cultivated plants are frequently found as 'relics' in formerly inhabited but abandoned places. Botanists base their conclusions often on the influence of man on the flora during the present era only or, at most, back to ancient Egypt. It is often believed that history began to be important with the rise of early civilizations such as the Egyptian, Chinese and the like but this is decidedly incorrect. It should not be assumed on the other hand that, in ancient times, man did not exert much influence on the vegetation because of his small numbers or low standard of living. A very scarce population can exert in the tropics a predominating influence on the vegetation under monsoon conditions and even determine its character. Some of the anthropogens may have spread therefore from 'time immemorial'.

(c) Thirdly, cultivated plants sometimes escape from cultivations and settle temporarily in the forests, or are even able to seek refuge and survive in some ecological niche. An example is *Coffea*. The so-called 'Bosch-koffie' is coffee plants originating from seeds dispersed by animals and found in the forest; formerly this kind of coffee was highly valued. Coffee may be expected to be able to maintain itself to some extent in Malaysian forests being originally a substage pygmy tree.

(d) Cultigens are known to produce secondary retrogressive forms which is a fourth difficulty in tracing their ancestors. These secondary forms suggest sometimes an approach to the original type although they still differ in certain characters.

Among Malaysian botanists, O. BECCARI (1) thought and wrote most about the problem of the origin of native cultigens. He called these 'plants united to man by a kind of symbiosis'. He studied the mangosteen: *Garcinia mangostana* L. which has certainly a West Malaysian origin. BACKER found in Java only ♀ specimens of this plant (6). *Areca catechu* L., or 'pinang' palm is, BECCARI says, what the camel is to the Arab. It has followed him in all his wanderings; its origin is unknown. Its nearest ally appears to be *Areca concinna* THW. of Ceylon; its nuts are indispensable for chewing 'sirih' or 'betel' leaves, and the nuts are attributes in ceremonials and rites. The slender beautiful stature of this palm has stirred the poetic sentiments of Malay writers. The sirih leaves are produced by *Piper betle* L., which is also a cultigen. The third participant in the 'man-sirih'-symbiosis,



'gambir', prepared from the adstringent tissues of *Uncaria gambir* ROXB. again is a cultigen of uncertain origin. BURKILL (2) says that 'gambir' is cultivated where it occurs wild but it has never been possible to prove that the wild plants did not escape from cultivation.

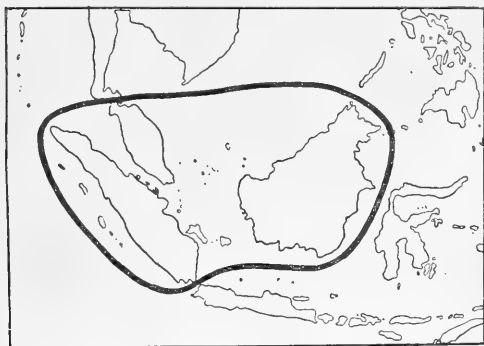


Fig. 50. Distribution of the genus *Durio* (Bombac.).

*Durio zibethinus* L. is another remarkable Malaysian fruit tree, which was subject to special studies by BECCARI (3). The genus *Durio* is restricted to West Malaysia (fig. 50). *Durio zibethinus*, a large tree, has never been found wild, though various native closely allied species occur in the primary forests. The custom of the Malays to plant fruit trees in the primary forests in abandoned clearings has led to the belief that those species occupy a natural habitat there (1, p. 166). The closest native ally is probably found in South Sumatra. I collected it and it was recognized as a new species: *D. spontaneus* BAKH. ms.

Another plant studied by BECCARI is the common 'rambutan', *Nephelium lappaceum* L., which occurs in numerous varieties. He found (1, p. 130) in some place in Borneo 5 species resembling the common *N. lappaceum* L. but which were distinct and undescribed. This raised the question whether these are hybrids between the cultigen *N. lappaceum* L. and allied native species. It is very interesting to discover in one village 5 cultivated congeneric species bearing excellent fruits, at that moment unknown to science. In another locality he saw, in a restricted area, five different native, apparently endemic species of banana (*Musa*). He supposed that they may be the result of retrogression towards a wild state of hybrid cultivated forms (1, p. 159).

BECCARI discussed at length *Eugeissonia utilis* BECC., a palm which is apparently in the second stage of domestication (1, p. 306). *Pandanus* appears to be in a similar stage in the Papuan highlands.

Many binomiums have been assigned to forms which certainly do not deserve specific rank, e.g. *Saccharum edule* HASSK. This is a monstrosity and probably of hybrid origin.

*Pisonia alba* SPAN., the cabbage tree of the Moluccas, is quite different in habit from its assumed

wild ancestor *P. sylvestris* T. & B. which is a very inconspicuous shrub. The cultigen hardly ever flowers, its foliage is yellowish (etiolated) (fig. 49), and its origin still is an unsolved problem.

Dr TOXOPEUS (4) studied the ancestry of some cultigens including the clove and kapok. The Zanzibar clove, though originating from the Moluccas, was never rediscovered in its native country where it may have been exterminated! The Asiatic-Malaysian kapok belongs to a distinct subspecies — acc. to BURKILL even a good species — of a species distributed in America and Africa.

In conclusion a list of genera is given below containing cultigens (species or varieties) which in all probability were obtained from the original Malaysian flora. The list is not exhaustive and serves to illustrate merely the number and diversity of cultigens in a tropical arboreous flora.

<i>Antidesma</i>	<i>Colocasía</i>	<i>?Ocimum</i>
<i>Areca</i>	<i>Dioscorea</i>	<i>Pandanus</i>
<i>Arenga</i>	<i>Durio</i>	<i>Piper</i>
<i>Artocarpus</i>	<i>Eugenia</i>	<i>Pisonia</i>
<i>Averrhoa</i>	<i>Flacourtia</i>	<i>Rattans</i>
<i>Baccaurea</i>	<i>Garcinia</i>	<i>Saccharum</i>
<i>Bamboos</i>	<i>Langium</i>	<i>Sandoricum</i>
<i>Bouea</i>	<i>Mangifera</i>	<i>Spondias</i>
<i>Citrus</i>	<i>Metroxylon</i>	<i>?Tamarindus</i>
<i>Cocos</i>	<i>Morinda</i>	<i>Zalacca</i>
<i>Codiaeum</i>	<i>Musa</i>	
<i>Coleus</i>	<i>Nephelium</i>	

*Cited literature:* (1) Wanderings (1902) p. 25, 27, 28, 60, 129, 130, 160, 166, 210, 308. (2) Dict. Econ. Prod. Mal. Pen. (1935) 2198. (3) *Malasia* 3, p. 230. (4) *Natuurwet. Tijdschr. Ned. Ind.* 101 (1941) 19–30. (5) *Blumea* 6 (1948) 246. (6) *Schoolflora voor Java* (1911) 91.

#### 19. Extinct plant groups in Malaysia

The reason why plants and plant groups become extinct has been the subject of many hypotheses and suppositions. As far as I am aware no general ground for discussion has been established hitherto in botany. The rosy idea that we live in a progressively better equipped world seems rather far-fetched, and extinction remains a mystery.

From Malaysia some examples of partial extinction may be given. *Dryobalanops* is a small genus of *Dipterocarpaceae* of ca 7 species now confined to Central Sumatra, the Malay Peninsula, and Borneo (cf. fig. 44). It occurs gregariously in the primary forest in colonies or aggregates. In the Tertiary period it was also found in South Sumatra and West Java, where it was also gregarious, judging from the enormous amount of large silicified trunks preserved.

It has been suggested that in the Tertiary Java was subject to violent volcanic action. Our experience and knowledge of the destruction brought about by vulcanism is, however, that the effects may be severe but are *always local*, especially in the lowland surrounding the volcano. It was in the lowland that *Dryobalanops* thrived. It seems

highly improbable that a flora would be completely destroyed over hundreds of sq. miles and even if this explanation is tentatively accepted the problem remains: why is *Dryobalanops* extinct in South Sumatra?

Another suggested explanation is that man

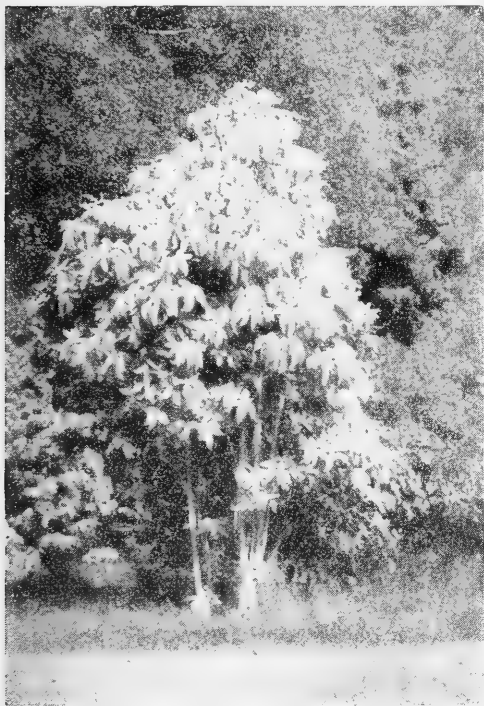


Fig. 49. The Moluccan 'cabbage tree', *Pisonia alba* SPAN. (*Nyct.*), a cultigen derived from *P. sylvestris* T. & B.

destroyed the species in Java; but it seems strange that no trace of it is ever found there even in the patches of primary forest left in remote spots.

It is also asserted that the Javan lowland forests were destroyed through submergence at the period when Java consisted of a garland of volcanoes as the Lesser Sunda Islands do now. But, if so, *Dryobalanops* would have found a temporary refuge at the base of the cones up to ca 300 m.

A reason for the extinction of lowland plants might nevertheless be found in *submergence*. Large tracts of land in Malaysia were left dry during the Pleistocene Ice Age, both on the western (or Sunda) shelf and the eastern (or Sahul) shelf. After

the retreat of the Ice, these large shelf areas were again inundated by the South China and Arafura Seas respectively. Though the change was gradual and the shelves were flat, it seems possible that migrating new species were caught by the final inundation by the sea, if they were unable to keep pace with the retreat of their ecological habitat.

Extinction of mountain plants is more likely to have occurred. The Malay Peninsula and the islands in the South China Sea (Riouw, Banka, and Billiton) have been above sea-level for a long period, even on a geological time scale. Their surfaces were subject to tropical erosion, and thick layers were washed off. By abrasion the old basic granites of the Peninsula were laid bare. Lofty mountains must have pierced the clouds where now but two summits of the Main Range just reach the 2400 m contour. The medium mountains have been gradually eroded to low hills or lowland. I am certain that the Peninsula formerly had a much richer mountain flora than at present. One of these remnants is a most peculiar sedge *Oreobolus kukenthalii* STEEN. (*Schoenus distichus* RIDL.). I found this in N. Sumatra in a geologically similar habitat but at a much higher altitude than in the Malay Peninsula where it occurs only on the Kerbau and Tahan summits between 2200 and 2400 m (N. Sumatra: 2450-3460 m). Apparently *O. kukenthalii* is on the verge of extinction in the Peninsula. The nearest locality of the genus is Mt Kinabalu, in N. Borneo, where *O. ambiguus* KÜK. occurs at 3750-4000 m. The fact that both Kinabalu and N. Sumatra have some specialized microtherm plants in common, which occur also on the summits in Celebes, the Philippines, and New Guinea (*Centrolepis*, *Monostachya*, *Patersonia*) renders it highly probable that these plants also formerly accompanied *Oreobolus* in the Peninsula, but were unable to maintain themselves in the gradual lowering of their habitat due to the erosion of the mountains.

Similar great changes happened to the floras of now extinct volcanoes; some of these have been practically reduced to their base, and nothing now shows except some small magmatic cones (1).

Changes of still greater magnitude have taken place in New Guinea where the geologically young alpine ranges are built of materials which have come from the demolished remains of former mountain systems now almost vanished.

The intricate and turbulent geologic past of the Malaysian Archipelago leaves no doubt of the ample opportunities for extinction and isolation in the plant kingdom. New data and arguments elucidating these events will in all probability be deduced from the phytogeography of the present flora.

*Cited literature:* (1) De Trop. Natuur 23 (1934) 163-167.

C. G. G. J. VAN STEENIS



### A Map, depicting the State of Malaysian Phytography till the Seventeenth Century

# SHORT HISTORY OF THE PHYTOGRAPHY OF MALAYSIAN VASCULAR PLANTS

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## INTRODUCTORY REMARKS

For various reasons the space occupied by pre-Linnean Malaysian phytography in this concise history seems too large and out of proportion in comparison to the survey of post-Linnean work. Modern plant description, though based on, and derived from, ancient beginnings and traditions, maintains but slender contacts with plant sciences earlier than the 18th century and it might claim to be allotted by far the larger space on account of its superior results, its greatly increased efficiency, its consciousness of limitations and capabilities, its output, and its clearness of purpose.

There exists, however, during the last decade, an increasing interest in the nearly forgotten botany of centuries long past, not only because of a certain taste for the quaint and attractive flavour of scientific efforts from minds so remote from our own, but also on account of a growing insight into the hidden springs of modern thought and method, which flow deeply, emerge unexpectedly, and appear to rise from distant roots. There is also, in connexion with this, the absorbing spectacle of discovery and of growth *i.e.* the development of a field of human culture that has bound devoted and excellent personalities in its service from the first glimmerings of our civilization.

Phytography is defined here as the art and science of describing plants by words or images with an intent to depict their appearance accurately, which is usually connected with the aim of furnishing a means of distinguishing one kind from another.

In LINNAEUS's time, phytography has found its manner of expression; its main standards and its technique, broadly speaking, were set. Later authors might conceive new or better views or adopt improved methods but the principles remained unchanged. The history of pre-Linnean phytography, therefore, deserves the scrutiny and study it is now receiving; it is an essential step towards an understanding of the rise of more recent descriptive botany.

It has also been necessary to reduce the chaos of literature connected with 19th and 20th century Malaysian phytography to proportions which allowed a survey of the course of events; any summary of the publications on the subject with a view to completeness otherwise than in a vast bibliography of titles, threatens to swamp the reader

with an endless sea of names. A severe selection has been unavoidable, and much deserving work has had to remain unmentioned, simply because admission of more references would have outgrown the adopted limits. May the choice, now made, not be too often unjust.

As regards the last decades, a practical reason for reducing the discussion of post-Linnean phytography is that many phytographers to whom reference would have had to be made because of their important work, are still among us, and so more comment than a brief review of their publications would be out of place.

A history of Malaysian phytography ought not to be composed without regard to its surroundings and background as phytography forms part of the general history of the natural sciences. It was not intended, however, to make a broad survey (*e.g.* in the manner of SIRKS's *Indisch Natuuronderzoek*), nor were plant collectors or collections mentioned beyond a very broad outline, though plant collecting, of course, must precede plant description. The data concerning the securing of the materials are being arranged in the first volume of this Flora. Biographical facts are in this short history but sparingly given and, very often, may be preferably traced through the references contained in the first volume just mentioned. Finally, it must be realized that bibliographical particulars, or exhaustive lists of publications, should find their place, at some future date, in a Malaysian bibliography.

The early contributions to Malaysian phytography were incidental. According to the data incidentally supplied to European naturalists by some eccentric sea-captain, or observant traveller, new facts reached the printer. Very often it cannot be ascertained whether some botanical discovery described from 'the East' or 'the Indies' is Malaysian or not. Even to the 18th century botanist, 'India' meant the tropics between Arabia and China (and Australia), and it would scarcely be worth while, it was believed, to distinguish between the SE. Asiatic continent and 'India Aquosa'; they were, it was thought, covered by a similar vegetation.

In the following paragraphs, no effort has been made to disentangle what never was intended to be kept apart, and the 'Indies' are 'defined' as in pre-Linnean times. Of course, it was attempted to

demonstrate how Malaysian phytophany crystallized from its confused beginnings until, in the 19th century, it became distinctly demarcated and developed more and more independently. In the past hundred years, this independency tended to turn into isolation, which was still more accentuated by political boundaries and led, sometimes, to a neglect of the flora of neighbouring regions to the detriment of phytophany.

As regards the description of Malaysian plants, I have felt that those species should be accepted as Malaysian which are now met with in the region, irrespective of whether they are new arrivals now commonly cultivated or forming a notable part of the vegetation, or whether they are truly autochthonous. Malaysian phytophany and the *Flora Malesiana* have to deal with both immigrants and residents of long standing.

## PHYTOGRAPHY BEFORE THE SETTLEMENT OF THE EUROPEANS

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### 1. The oldest traces

Botanical sciences in tropical Asia remained essentially superficial and were directed solely to utilitarian or religious purposes till the arrival of western explorers. Ancient Chinese and Indian authors, twenty to thirty centuries ago, refer repeatedly to Malaysian vegetable products. Chinese seafaring traders from time immemorial carried cloves, areca nuts, sapan wood, and other renowned produce from Malaysia to China and when commenting on their treasures, composed the earliest descriptions of plants in the eastern tropics (1). These are of little value phytophographically, being vague and obviously intended to facilitate economic enterprise.

*References:* (1) BRETSCHNEIDER, *Botanicon Sinicum* 1-3 (1881 or '82-1895).

### 2. The Hindus

The peoples inhabiting the Indian peninsula and adjacent territories though closer acquainted with Malaysian plants, were occupied in describing their medical virtues in the first place but also concerned with the religious and economic aspects of some kinds. E. F. H. MEYER, an authority on ancient Indian botany, concluded (1) after discussing the AYURVEDAS, the main Sanscrit botanico-medical work of uncertain age, that it contained between 600 and 700 plant names but, he said: (transl.) "I doubt whether a single one's identity might be guessed with any likelihood of accuracy from the casually mentioned characters, and nothing is found in other Sanscrit works resembling any real plant description."

The great temple of Borobuddhur built in Central Java in the 8th and 9th centuries when the Buddhist kingdom of Mataram flourished, is covered with reliefs; these have been subjected to some botanical study. As was to be expected, the pictures of plants carved in stone by craftsmen who were sooner artists than botanists, hold but a limited interest from a phytophographical point of view. It is uncertain if the sculptures are stylized representations of species native to the remote country

of origin of the builders or, possibly, are adapted portraits of plants occurring in East Java. The absence of the rice plant is remarkable (2).

I know of no work of Malaysian native origin that contributed to Malaysian phytophany appreciably.

*References:* (1) MEYER, *Geschichte der Botanik* 1-4 (1854-1857). (2) BAKHUIZEN VAN DEN BRINK Sr in *Trop. Natuur* 20 (1931) 181-186, also CAMMERLOHER *ibid.* p. 141-152, and STEINMANN, *ibid.* 31 (1934) 198-224.

### 3. The Greek

Europe received its first scraps of information through CTESIAS, court physician to ARTAXERXES, ruler of Persia (c. 400 B.C.) who among his tributes from tropical Asia received rare animals or plants. CTESIAS, when writing to Greece, reported faithfully on these wonders of nature adding, however, in good faith all the fabulous stories brought into the bargain. His letters were edited and further elaborated by HERODOTUS and, in the 17th century, by GRONOVIVS (1). There was the marvel of 'the reed that grew nearly as high as a ship's mast' and a shrub producing a wool finer and better than that of sheep (2).

When ALEXANDER's armies penetrated into the regions of the Indus and the Punjab (330 B.C.), he was accompanied by scientific advisers who had a keen eye for botany. They came across the Banyan tree (*Ficus benghalensis* L.), and their notes enabled THEOPHRASTUS, the father of plantgeography, to write his excellent account of the great tree which 'sheltered an army under its boughs'. They called it 'Indian Fig', a name which has been a source of much confusion afterwards, and explained correctly its peculiar habit by stating that a central trunk gave rise to horizontal branches from which aerial roots descend till the earth is reached. Penetrating into the soil these roots stiffen, thicken, and gradually assume the appearance of a secondary columnar tree trunk which supports the heavy boughs spreading from the primary central trunk. This habit is typical of several very closely allied species of tropical figs, native of Malaysia or adjacent regions.



AMES



BACKER



BAKHUIZEN SR



BAKHUIZEN JR

The Greek noted that the pendent growth from the branches was at first tender, of a light colour, and hairy, and THEOPHASTUS decided that the true nature of the 'secondary branches' was that of roots (3).

These accurate Greek observations and interpretations, were overlooked and misunderstood by later authors. A higher appreciation of Greek phytophraphy results if it is realized that a professional European gardener, G. MEISTER, who worked in the 17th century for several years in Java, described (4) this (or a similar species) as having roots growing vertically from the ground upwards till merging into the branches. Among 18th century travellers this story is, in a revised edition, still commonly repeated, when they speak of the tree which bends its branches downwards till they strike root. This tale, in fact, goes back to PLINIUS, and even to the Indian vernacular name which ascribes to the Banyan 'downward growing branches'. A recent American book, by N. S. KNAGGS, the popularly written account (5) of a plant hunter in the tropics, caps all previous efforts in telling the story of the fig tree which sinks its branches into the soil, these emerge again and grow upright to a new tree, again to sink and to emerge, and so the tree marches through the forest. This may serve as an instance of the errors of fanciful explorers and the merit of data obtained by sober unbiased observers.

The botanical studies of THEOPHASTUS are lost for the greater part but the remainder contains, for example, a description of *Cycas* and of the mangrove community. The data pertain, actually, to the mangrove of the Persian Gulf but as the aspect and composition of this plant community on the mudflats and beaches in tropical coastal waters hardly varies in the whole of its area, these first notes have their interest also in relation to Malaysia. The habit and stilt roots of *Rhizophora* were compared to 'cuttle-fish grasping the soil' and it was observed that the fruit of *Avicennia* had internally one 'seed-leaf' folded round the other. The attempt to distinguish between the kinds of mangrove trees was not successful.

The botany of ancient Greek authors as regards tropical plants has not been exhaustively studied; it demands a knowledge of languages and an experience of systematic tropical botany as is rarely

found in one person (6). The works of MEGASTHENES ( $\pm$  300 B.C.), the first European to see and report on *Borassus flabellifer* L., are among many still to be searched (3).

*References:* (1) cf. C. MÜLLER in HERODOTUS, ed. DIDOT (1858). (2) BALL, in Proc. Roy. Irish Acad. sér. 2, II (1885) 336. (3) GREENE, Landmarks of Botany I in Smiths. Misc. Coll. 54<sup>1</sup> (1909) 1-329. (4) MEISTER, Der Orient.-Ind. Kunst-u. Lust-Gärtner (1692). (5) KNAGGS, Man's first plastic (1947). (6) BRETZ, Botanische Forschungen des Alexanderzuges (1903), also VINCENT, Suppl. Commerce and Navigation of the Ancients, 2 vols (1807).

#### 4. The Egyptians

The Egyptians, destined by their geographical position to hold the main port-of-call for traders with the East, received in the first century about 45 kinds of vegetable products from the East Indies. They were on the alert when plants of economic promise were to be introduced and at that time had e.g. *Arum esculentum* L. in cultivation. KUNTH's record of *Mimusops elengi* L. rests, however, on a misidentification (1). The first century must be regarded as the earliest period of regular connection with western Malaysia; nutmegs and (decidedly later) cloves from eastern Malaysia reached Alexandria only towards the close of the second (2). Phytophraphy may seem to have been little developed but the possibility cannot be excluded that works of importance were destroyed in the great fire of the Alexandrine library. Only in the 6th century, COSMAS INDICOPLEUSTES, Greek-alexandrine seafaring philosopher and explorer, brought home some descriptive notes on pepper and the cocos palm (3). Even accounting for possible losses, it would seem that (Malaysian) phytophraphy after the decline of Greece, in the first ten centuries of our era was held in little or no esteem among the scholars though some modest achievements from Arabian sources may be mentioned.

*References:* (1) cf. PICKERING, Chron. Hist. Plants (1879) 618. (2) MEYER, Geschichte der Botanik 1-4 (1854-1857). (3) COSMAS, Topographia christiana, ed. THEVENOT, Relation des voyages 1 (1695), also VINCENT, Commerce and Navigation of the Ancients 2 (1807) 111, 505.

5. *The Arabs*

The Arabs, in their splendid but brief period of dominance (c. 700–1200), were active traders between the Persian Gulf and Kedah on the Malay Peninsula and contributed in some degree to Malaysian botany. Following MEYER (1), I quote the name of ISHAQ BEN AMRAN ( $\pm$  900) who made good descriptions of Indian fruits and roots and in particular a good pen portrait of *Ipomoea* (*Pharbitis*) *nil* (L.) ROTH. A travelling geographer of the 11th century, MASUDI, reported on 'Cubebo' (*Piper cubeba* L.) from Java. He said that 'on an island in the far South' a tree occurred 'with fruits resembling human heads crying 'wak, wak', which is possibly a reference to *Hernandia peltata* MEISN., a shore tree with spherical vesicular fruits which produce a humming sound in the wind. There are also the famed writings of ABU ALI HUSAIN IBN-ABDALLAH IBN-SINA or AVICENNA (980–1037), who brought from India the first accurate reports of *Musa* and the coco palm (1).

Twelfth century records, among a shapeless mass of confused data, contain a description of 'a fruit four palms long, round, resembling a shell and with a red skin; inside an acorn-like kernel rests. When roasted it is eaten like a chestnut whose taste it also possesses. The flesh of the fruit is very sweet and a pleasing food, in which the flavour of the apple and the pear are combined, and it even suggests the banana and the 'Moql'. It is an attractive fruit, estimated above all in the Indies'. This has been interpreted as a Bread fruit, but I believe that MEYER is undoubtedly right in recognizing this as *Mangifera indica* L. though a truly red colour is not found among Mangoes. The recognition of the shape of the shell in the contour of a mango fruit is the touch raising the description to fine phytophotography.

Arab botany as a whole was compiled by IBN BAITHAR (or IBN-EL-BAITHAR), an Arab of Spanish birth, who died in 1248 after far travels but without visiting the Indies (1). He was probably the best informed of the 13th century Arab scholars. His *Mofridat* or Catalogue, is an enumeration of 2600 alphabetically arranged entries on medicine, among which are 1400 plants, elucidated with descriptive notes, some original but the majority copied or translated. There is no doubt that the book contains data on Malaysian phytophotography. He used, for instance, the Greek works as sources but knew in addition the biological peculiarity of several mangrove trees of bearing germinating seeds on the tree. His compilation is the main key to Arab knowledge of natural history. Soon after, Arab botany lags behind and no longer demands attention.

References: (1) MEYER, Geschichte der Botanik 1–4 (1854–1857).

6. *Early explorers (Portuguese, Spanish, Italian)*

From Constantinople, starting point of the land routes to the East, members of the Venetian merchant family POLO, in 1264, set out for the journey

into Asia which was to mark the history of the world. MARCO published in 1296 the narrative of his travels. In 1292, when visiting northern Sumatra, he found rice cultivated there and made some notes concerning *Arenga pinnata* (WURMB) MERR., *Cocos nucifera* L., *Dryobalanops aromatica* GAERTN. f., and collected seeds of a plant which was taken 'with the roots and used for dyeing'. This was a species of *Indigofera*. He also wrote an account of *Metroxylon* (1).

The Italian Franciscan friar, ODORICO OF PORDENON, in India the first missionary upon record, wandered through Ceylon (1331), Malabar, Java, Sumatra, and the Moluccas, told of sugar cane, of *Arenga*, made a particularly good description of pepper, and gave the earliest reliable account (2) of the occurrence of siliceous concretions in the hollow internodes of bamboo ('tabasheer'). There are the first vague allusions to the 'most terrible poison of the world', heralding the sensational literary career of the Upas tree (*Antiaris toxicaria* LESCH.), which were, possibly, confirmed by his contemporary fellow missionary JORDANUS CATALANUS, who saw (c. 1335) in the islands of spices a tree which, when in flower, killed everybody (3).

NICOLA DI CONTI, MARCO POLO's compatriot, gave in the 15th century the earliest description of a Bornean plant from personal observation (*Piper*), and added accurate notes on camphor, mango, *Artocarpus integra* (THUNB.) MERR. (Jack fruit), and other fruits; his lucid story of the Cingalese cinnamon tree and its product is also the earliest (1444); he was in India between 1420–1440. His work is inserted in RAMUSIO (4).

Towards the close of the 15th, and in the beginning of the 16th century, the Portuguese penetrated into the East; in Europe, somewhat later, scientific botany came to life. New standards were set for the representation of plants in painting or drawing by O. BRUNFELS (1530) and L. FUCHS (1542), for description by V. CORDUS (1563), and for taxonomy by A. CAESALPINUS (1583), but during Portuguese supremacy in the Indies little notice was taken of the progress of phytophotography in Europe.

The explorer DUARTE BARBOSA, a man of uncommon ability whose work is a main source of information on the first decades of Portuguese settlements (c. 1500–c. 1520), showed little interest in botanical sciences and so an unparalleled opportunity for study in these fields during his long and repeated visits to the East Indies was largely missed. He has made, however, the first good description of nutmeg and clove trees. In Malacca he saw 'the great ships coming from the kingdom of Java' and noted that 'the cables and all the shrouds of these ships were made of canes which grow in the country'. Among many articles rice, garlic, and onions were imported (4).

ANTONIO PIGAFETTA, some time his companion—both partook in MAGELHAËS's voyage—gave better information; he observed the occurrence of melons, gourds, cucumbers, cabbages, and onions in North Borneo at that time. The descriptions of clove and nutmeg, and their cultivation, were much improved (5).



In 1526, New Guinea was reached by the Portuguese (perhaps even before), and they remained in power in Malaysia till the 17th century though, after 1580, under the banner of Spain. The botanical results of that period are small; glimmerings of some attention to phytophagy are few and far between. MANOËL G. DE EREDIA wrote, after FERDINANDEZ LOPEZ's rough outline, a meritorious account of the Moluccan sago palm (6). CHRISTOPHORUS A COSTA, acting surgeon on the coast of Malabar and Cochin, made chiefly compilatory studies, preferably on medicinal plants. Some of his notes deal with *Croton tiglium* L. which he knew to originate from the Moluccas; its seeds ('grana de Molucco') were a famed remedy. He recorded and described the new arrival, *Anacardium occidentale* L. at Cochin and stated that *Ananas comosus* (L.) MERR. was brought in 1578 to the East, and in 1599 first to Java. A strikingly good description of *Nyctanthes arbor-tristis* L. is from his pen (7).

Easily first among contemporary scientists in the East ranks GARCIA AB ORTA, a name probably referring to a botanical garden (the first in India) which he established near Bombay and where he studied and described the plants brought home from his travels (8). A landmark in the history of civilisation is the publishing of his *Aromatum Historia*, the third European book to be printed in the East Indies (1563). Pharmacology was the main theme but in addition botanical observations were allowed space. GARCIA described the leaf movements of *Tamarindus indica* L. and the reactions of the foliage of *Biophytum sensitivum* DC., and drew a sharp distinction between sappan wood (*Caesalpinia sappan* L.) and red santal wood (*Pterocarpus santalinus* L. f.); *Strychnos* was treated in connection with its powerful medicinal virtues.

Finally I mention NICOLÒ MONARDES, founder of a Colonial Museum at Sevilla in 1554, who gave a good description of the circular, flat, winged pod of *Pterocarpus indicus* WILLD. while perceiving the

outline of a dragon in the course of the veinlets on its surface as he had been informed that the tree exuded a red resin, that resembled the renowned 'dragon's blood'. He also first described the fruits of *Sapindus rarak* DC. which produced a soapy froth in water (9).

These occasional contributions to phytophagy prove that no lack of skill or of observation caused the crop of good descriptive work to be so meagre; the mind of the author of the day only rarely freed itself to such an extent from the all-pervading desire for profit to body or purse, that it became inclined towards the seemingly unnecessary, and at any rate unusual, achievement of delineating plants by means of fitting words or phrases. Nearly always the description was accompanied by a stated reason for it, as it were an apology; a plant was described, the phytophagist hastened to say, because it was a rarity, a poison, a spice, or whatever the case may have been, but not for its own sake, unexplained, and not with the main purpose of rendering its characters available to comparative scientific study.

References: (1) POLO, ed. YULE and CORDIER (1903) and Add. (1920). (2) ODRIC DE PORDENONE, ed. CORDIER (1891), also MULLER, Voorloopers en navolgers van Marco Polo (1944). (3) VINCENT, Commerce and Navigation of the Ancients, 2 vols (1807). (4) BARBOSA, ed. DAMES 2 vols (1918-1921), also RAMUSIO, Navigazioni e viaggi vol. 1 (1554). (5) PIGAFETTA, ed. ALDERLEY In The first voyage round the world by MAGELLAN (1874) 35-163. (6) EREDIA, Informação da Aurea Chersoneso 1599 (1st ed. 1807); Malaca, l'Inde Méridionale et le Cathay (1862). (7) A COSTA, Tractado de las drogas y medicinas de las Indias Orientales (1578), ed. CLUSIUS 1593). (8) AB ORTA, Coloquios dos simples (1563), ed. FICALHO 1891), Aromatum et Simplicium . . . historia (ed. CLUSIUS 1567). (9) MONARDES, Dell' historia . . . semplici aromati . . . dall' India Orientali pertinenti (1589).

## MALAYSIAN PRE-LINNEAN PHYTOGRAPHY IN EUROPE

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### 7. Van Linschoten

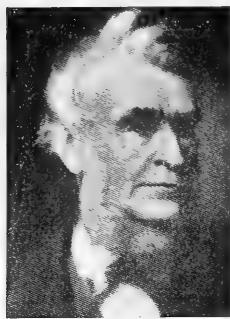
The rise of the 17th century Dutch empire in the East was accompanied by an equally splendid development of sciences at home. The very first of the Dutch bent on discovering the route to the East actually to arrive at Goa, JAN HUYGHEN VAN LINSCHOTEN, collected so many botanical data among a wealth of other information (1) that he seems to introduce a new era of discovery and scientific progress. His descriptions though more independent of previous works than those of his contempo-

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raries, are not quite free from superstition and the time-honoured custom of copying earlier authors, then judged a hallmark of learning and good sense but, nevertheless, he shows a keen eye and a lively spirit. It seems in place to enumerate the best of his descriptions: they are of the pineapple (*Ananas comosus* MERR.), Jack fruit (*Artocarpus integra* MERR.), mango (*Mangifera indica* L.), cashew nut (*Anacardium occidentale* L.), djambu's (*Eugenia spp.*), lobi-lobi (*Flacourtia inermis* ROXB.), gandarria (*Bouea gandaria* BL.), citrus (*Citrus spp.*), and include notes on the bisexuality of paw paw (*Ca-*



BECCARI



BENTHAM



BINNENDIJK



BLANCO

*rica papaya* L.), of the 'Indian fig' or bananas and plantains (*Musa spp.*), coconut (*Cocos nucifera* L., fully a treatise!), sweet potatoes (*Ipomoea batatas* LAMK), durio (*Durio zibethinus* L.), bamboo (*Dendrocalamus?*), sugar cane (*Saccharum officinarum* L.) and several other plants e.g. *Datura sp.* and *Nyctanthes*. Of course, commercial vegetable products such as spices and condiments, got due attention and full reference was made to pepper (*Piper nigrum* L.), cinnamon (*Cinnamomum zeylanicum* BL.), cloves, nutmegs, ginger, cardamon (*Elettaria cardamomum* MATON), lacquer (*Rhus sp.*), benzoë (*Styrax benzoin* DRYAND.), santal wood, eagle wood (*Aquilaria malaccensis* LAMK), camphor, tamarind (*Tamarindus indica* L.), cassia (*Cinnamomum cassia* NEES ex BL.), &c.

Born at Haarlem in 1563, LINSCHOTEN lived from 1583–1589 at Goa and at Cochin, from 1589–1591 in the Azores; in 1592 he returned to Enkhuizen. PALUDANUS (BERENT TEN BROECKE) received all his plant specimens and edited his *Itinerario* in 1595 (2nd vol.) and 1596 (1st vol.), adding learned commentaries to LINSCHOTEN's observations in the pompous style of the day borrowing many data from GARCIA. The book was copiously illustrated, the botanical figures were made by JOANNES and BAPTISTA à DOETECHUM. The elaboration and systematical study of LINSCHOTEN's materials as a whole by an experienced botanist inaugurated the

custom of later centuries, and was a distinct improvement of method.

References: (1) LINSCHOTEN, *Itinerario* (1595–1596).

#### 8. The East India Company

In 1600, after some preliminaries, the Dutch East India Company was founded, and chartered in 1602. The Honourable Company, if not described in our time as a conspiracy of robbers and heartless oppressors, at least by many judged to have been nothing better than a body of greedy traders, behaved, it is a pleasant historical truth to record, honourably towards natural sciences and obstructed scientific progress rarely and only when its results were believed to be directly contrary to their interests. The exemplary phytophographical works of the 17th and 18th century, which ensured Holland a leading position in botanical knowledge at the side of Britain, have been achieved almost without exception through the Company's benevolent attitude towards botany and the generous support of its directors.

Without delay, in 1602, a special order was issued to all apothecaries and surgeons of the Fleet to collect and dry specimens not only of tradable plants but also of all other kinds which might be secured, and to make notes and drawings of them.

"Recommendation for Apothecaries and Surgeons sailing on the fleet in the year of 1602 bound for the East Indies.

They shall bring, laid between paper, branchlets carrying leaves and fruits and flowers whenever possible of: nutmegs both species male and female, black pepper, white pepper, long pepper betle, cubebas, mangoes, mangosteens, and similar beans of a kind of cotton growing in Bantam with branchlets and leaves and enquire after their local names.

Similarly branchlets of all other kinds of trees that seem strange and grow there with flowers leaves and fruits, when possible the habit of the trees to be designed, whether they are large or small, whether green in winter or not. Their names in the vernacular, and to what end they are used etc."

"Memorie voor die Appotteckers ende Chyrugins dien den jaer 1602 op de vlote naer Oost-Indien vaeren sullen.

Dat zij mede brenghen tusschen pampier geleyt tacxkens met haer bladeren ende vruchten ende bloemen waert mogelijck, van: muscaten nooten beyde soorte mannekens ende wijfkens, swarte peper, witte peper, lange peper betle, cubeben, mangas, mangostoncs, ende diergelijcke boonen van eene soorte cattoen dat bij Bantam wast met tacxskens ende bladeren ende te vraegen hoedat sij daer noemen.

Item tacxkens van alle andere soorte van boomen die vrend sij, ende daer wassen met bloemen bladeren ende vruchten, soo mogelijck was de fatsoen van de boomen te teekenen, oft sij groot ofte cleyn syn, inde winter groen blijven ofte niet. Haer naeme op haer maniere, ende waertoe sij te gebruycken etc."

The taste for rarities of the period was rivalled by a scientific interest, the introduction of living plants into the European hothouses was enthusiastically tried and it may be said that, in the course of the 17th century, the botanists of the Netherlands came to possess the best information and collections of Malaysian plants.

### 9. *Clusius and his contemporaries*

Among the scholars of the period CHARLES DE L'ESCLUSE, or CAROLUS CLUSIUS, ought to be mentioned first. The European flora and that of the Near East took most of his time but he contributed materially to East Indian botany. The utilitarian principle CLUSIUS removed deliberately to a second place; his scientific views approached those of modern times and he followed a primitive binomial system, though not consistently. Most important to phytophraphy in particular, and to the science of plants as a whole, is his custom of referring to the names of previously described plants together with the name of their describer.

His trips to France and Spain (1564–1565) yielded him some additional data on tropical East Indian plants; returning he took AB ORTA's book with him and afterwards brought it to fame by his remodelling, condensation, and translation of the original (1). Under his supervision, PETER VAN DE BORCHT illuminated *Aromatum Historia* with 16 wood-cuttings (1567); the later English, French, and Italian editions are based on CLUSIUS's revision, not on the Portuguese text.

SIR FRANCIS DRAKE, after his voyage round the world (1577–1580), supplied him with observations and specimens, partly from Malaysia, gathered during the expedition. In 1582 CLUSIUS published *Aliquot notae in Garciae Aromatum Historia* dealing, however, with DRAKE's data mainly. CLUSIUS re-edited and enlarged DODOENS's *Cruydeboeck*; the 5th edition of this herbal (1608) contained a considerable appendix and a reasoned description of all known exotics. From the 'East Indies' more than 200 species are discussed (some pictured), practically all abstracted from CLUSIUS's previous studies. A complete list of the species would require too much space; it may be noted though, that cloves, nutmegs, areca, and cocos were—as usual—amply discussed but that in the whole of the work the endlessly redescribed objects of trade have lost their preponderance; they receive no more attention than is their due among the other plants of the East. Short notes announce in a preliminary manner new discoveries. *Mimosa pudica* L. is described and pictured; the fruits of *Sindora sumatrana* MRO., a popular vegetable in Bantam (*Blumea lacera* A.DC.), a twig of *Lannea coromandelica* (HOUTT.) MERR. from Batavia, and *Gnetum gnemon* L. were some of the novelties. In 1618 the 6th edition of DODONAUS's herbal appeared containing a first description and picture of a capoc fruit from Java.

A random instance which may illustrate CLUSIUS's merit as a phytophrapher and botanist is a brief discussion concerning a leaf he had received

from the Indies. The donor said it grew like *Nymphaea* in water, only its flowers were blue. This made CLUSIUS draft a close description of the fan-wise folded specimen and, evidently, a palm leaf is at hand, perhaps *Borassus* or, possibly, *Licuala*. CLUSIUS himself quietly doubts the relationship to *Nymphaea* and suspects affinity with the Palms! Considering the erroneous data, this proves clear insight. Leaving much unsaid regarding CLUSIUS's influence on East Indian phytophraphy, I wish to point to his descriptions of tropical plants in *Exoticorum libri decem* (1605), a small book of great importance. The first specimen from Bali is put on record (*Salacca edulis* REINW.) and, among many others, a plant which, I think, is a species from the mountains of Central or East Java (*Anaphalis* or *Gnaphalium* sp.); CLUSIUS referred it to *Lavandula*. In his *Rariorum plantarum historia* of 1601, the description of a Philippine plant occurred: *Illicium* sp.

CLUSIUS held the Chair of Botany at Leyden (1592–1599) and died in 1609. His manuscripts were partly edited posthumously and partly disappeared. Of his Herbarium no trace is left. To obtain a knowledge of Malaysian botany at the beginning of the 17th century, a detailed study of CLUSIUS's works would be indispensable; this ought to be based on the CLUSIUS monographs by F. W. T. HUNGER (2).

In many of the 16th century herbals in Europe chapters or appendices were devoted to tropical, partly Malaysian, phytophraphy, their contents being a conglomeration of earlier published notes and incidental scraps from traveller's stories. W. TURNER's *New Herball* (1551, 1562, and 1564) and the illustrated account in CASTOR DURANTE's Italian herbal (1585) of East Indian plants are about the best of contemporary writing on the subject. The *Pinax theatri botanici* (1623) of CASPAR and JOANNES BAUHIN, a first attempt towards a nomenclator, wants further investigation as regards Malaysian species; the brothers received directly, or by way of Holland, plants from Farther India, and their Herbarium is still preserved at Uppsala.

After CLUSIUS's death, the ardour to study Indian plants grew dim, the herbals of the first half of the 17th century repeating the available information and adding next to nothing to the store of knowledge. Seventeenth century wealthy plant amateurs, in Holland, England, and Central Europe, continued and stimulated the search for novelties from the Malaysian flora and so laid an excellent base for future descriptive writing. About the middle of the century, however, the scene of creative study had shifted and Malaysian phytophraphy was best executed in the East itself—as will be demonstrated later: only in the closing decades of the century, the centre of activity returned to Europe. In F. ERASMUS's *Ost- und West-Indischer Lustgarten* a summary of the known facts at that time (1668), written in GARCIA's fashion but of lesser quality, may be consulted; it deserves notice mainly to gauge the progress made in fifty years, which is not very impressive.

*References:* (1) AB ORTA, ed. CLUSIUS (1567). (2) HUNGER, Charles de l'Escluse 2 vols (1927, 1943).

#### 10. Hermann and Sherard

The work of PAULUS HERMANN revived interest among European scientists, and proved to be an important foundation upon which new original study was built. Born in 1640 in Saxony, he studied botany and, having graduated, went to Holland, there readily obtaining employment as a physician to the East India Company on recommendation of some plant-loving Directors. He then travelled widely, collecting in Africa, India, and Ceylon. Remaining in that island in office from  $\pm$  1672 till 1679, he made two considerable collections mainly from the coastal region of Colombo and, therefore, to a large extent of plants found also in Malaysia. He had some 400 drawings made. On being appointed to the Chair of Medicine and Botany at Leyden, he returned to Holland introducing many species for the first time. He built a Museum, rearranged the Gardens, and erected the first glass hothouses of the University. His initial illustrated work *Catalogus horti academico Lugduno-batavi* (1687) is little concerned with Indian plants, and his earliest contribution to Indian botany is contained in a section of *Schola Botanica* of 1689. Its author, who must have made a liberal use of HERMANN's notes, is indicated on the title page as 'S. W.A.'; the initials are believed to refer to SAMUEL (or SIMON) W(h)ARTON, AUCTOR, a pupil of HERMANN's. Some declare SAMUEL to be a 'mythical person' and adhere to the view that WILLIAM SHERARD is responsible for the publication. The initials then would mean 'SHERARDUS WILHELMUS ANGLUS'. I admire the ingenuity of the latter explanation but remain a believer in the one-time bodily existence of WARTON because in a Latinized author's name 'Wilhelmus' ought to have read 'Guilelmus' which demands 'G.' The problem is of bibliographical interest; the merit is HERMANN's. Among his collaborators L. PIJL, Governor of Colombo, is to be remembered, who sent many times living plants, often with descriptive notes used by HERMANN.

WILLIAM SHERARD or SHERWOOD, Founder of a Chair of Botany at Oxford, acquired after HERMANN's death (1695) his disordered manuscripts and notes, and in 1698 published *Paradisus Batavus*, a considerable work particularly well illustrated with 111 etchings. It gives e.g. a first system of tropical Asiatic *Araceae*. This was followed by a second work based on HERMANN's materials, *Museum Zeylanicum* (1717). Ceylon lies, of course, outside the boundaries of this present Flora, but the books contain descriptions of numerous plants then or now abundant in Malaysia, or of species common to both regions.

The main part of the Herbarium of HERMANN, consisting of 4 volumes of dried plants and one volume of drawings formed the base of LINNAEUS's *Flora Zeylanica* (cf. § 18). HERMANN's herbarium had been believed to be lost but came into the hands of an apothecary at Copenhagen who lent

it to LINNAEUS. After this elaboration, the specimens again changed hands repeatedly until BANKS purchased them and brought them into security in the British Museum. H. TRIMEN studied the plants of HERMANN anew (1867) in connection with *Flora Zeylanica* (1).

In the Rijksherbarium at Leyden is another set of HERMANN's plants in 2 volumes of excellently preserved specimens. A list of the species was composed by S. J. VAN OOSTSTROOM (2), who added titles of relevant literature (1937). The volumes contain probably a Cingalese collection sent by HERMANN to J. COMMELIJN (§ 11).

*References:* (1) Journ. Linn. Soc. Bot. 24 (1887) 129-155. (2) Blumea Suppl. 1 (1937) 193-209.

#### 11. Resident botanists in Holland

HERMANN's plants formed a large proportion of the material base of J. BURMAN's *Thesaurus Zeylanicus* (1737), a book of 235 pages and 110 plates. The *Thesaurus* shows no attempt towards any natural classification or outline of the main characters of the Cingalese flora. In it are enumerated alphabetically the genera; the species are quoted with reference to literature, the new ones being described with some accuracy. The book, though having no nomenclatural status introduces several generic names for the first time, which were later adopted and validated in Linnean publications (e.g. the Euphorbiaceous genus *Antidesma*). A list of vernacular names occurring in *Hortus Malabaricus* (see below), referable to more scientifically named plants in the *Thesaurus*, followed; the book is concluded by cataloguing some Cape collections.

J. BURMAN, born in 1707 at Amsterdam, was appointed there to the Chair of Botany in 1731. Though not greatly gifted as a botanist, he was a worker of considerable industry and ability; his death in 1779 was generally felt as a serious loss to science; his *Thesaurus* remained his only independent contribution to Malaysian botany (§ 21).

Concurrently with these developments at Leyden (§ 10), botanical science at Amsterdam was promoted by JOANNIS COMMELIJN, and his nephew CASPAR. JOANNIS, merchant and pharmacist, had had made a truly magnificent collection of coloured drawings of exotics cultivated in the Amsterdam Botanic Gardens ('Hortus Medicus'), but very scant attention was paid to plants from Malaysia. There are also only a few plants from the Indies described in the posthumously edited book of plants cultivated at Amsterdam *Horti medici Amstelodamensis rariorum . . . plantarum* (1697), consisting of 112 plates with text. J. COMMELIJN was one of the chief editors of *Hortus Malabaricus*.

His nephew CASPAR, published an extract of RHEEDE's work (see § 20) under the title of *Flora Malabarica* or *Malabaarse Kruythof* (1696), a publication mainly of bibliographical interest. CASPAR COMMELIJN largely limited his activities in the field of tropical botany to African and South American plants; his works of 1701 (2nd volume of *Horti medici* &c. with 112 figures, and chiefly based on J. COMMELIJN's manuscripts) and 1703, are both on



BLUME



BOERLAGE



BREMEKAMP



R. BROWN

plants cultivated at Amsterdam. These are his chief contributions to Malaysian phytophraphy but, from a general point of view, it may be stated that though the Amsterdam gardens are reputed to have housed in the first decade of the 18th century the richest collection of Malaysian plants in Europe, the works of the COMMELIJNS do not support this, being decidedly poor as regards information of Malaysian species.

Apart from the scientific studies at the Universities but closely interwoven with them, appeared the results of able, usually non-professional, botanists who spared no effort in advancing their hobby. They were attracted to the fine living collections of prosperous East India merchants who desired books honouring their botanical treasures.

Among many, the hothouses of H. VAN BEVERNINGK, Superintendent of the Leyden Botanic Gardens, at Warmond, were widely famed and won the love of the clever and clear-sighted Danzig merchant, J. BREYNE (BREYNIUS). In his student days at Leyden, BREYNE may have decided on this field of future work. On the whole, however, he studied European plants but, in spite of this, his works are of importance to every student of historical Malaysian phytophraphy. Many of the plates which GEORG MEISTER brought him from Java were published at his expense and he was one of the earliest recipients of living tea-shrubs, while BEVERNINGK's gardens supplied him with the materials both for his *Exoticarum Plantarum Centurio prima* (1678), and his two *Prodromi* of rare plants cultivated in Holland (1680, 1689). There is a final book of illustrations, *Prodromi . . . icones &c.*, by his son PHILIP in 1739. F. KIGGELAER's *Horti Beaumontiani Exoticarum Plantarum Catalogus* (1690), a careful (anonymously published) list of S. BEAUMONT's garden at the Hague, may be mentioned. The survey of this group of 'pre-Linnean' publications in Holland may be concluded by LINNAEUS's own famous studies of CLIFFORT's plants, to which I will return below (§ 17).

## 12. Kaempfer

ENGELBERT KAEMPFER, mainly known by his classic investigations into Japanese ethnography, certainly deserves recognition among the contributors to

Malaysian botany of that age. Born in 1651, at Lemgö (Lippe, Germany), he travelled as a surgeon in the service of the East India Company to Ceylon, Coromandel, Bengal, and Sumatra, interrupting his long journeys by a seven months' stay at Batavia where he found Governor General J. CAMPHUYS a generous host, a powerful friend, and an inexhaustible source of information concerning Japan. CAMPHUYS owned a fine mansion and a botanical garden in the islet of Edam in the Bay of Batavia and KAEMPFER, though penetrating into the surrounding region, spent most of his time in the garden of CAMPHUYS (1689-1690). After his trips to Siam, China, and Japan he revisited Batavia when returning in 1694 to Europe. He died in 1716 in his native village.

Of KAEMPFER's considerable botanical results next to nothing has been published but many manuscripts are kept in the British Museum. The unpublished *Miscellaneous collections* and his *Plantae in Insula Edam repertae* certainly contain interesting data on Malaysian plants. His book on the Far East, *Amoenitatum exoticarum . . . observationes &c.*, published in 1712, presents among the descriptions of Japanese plants some particularly close and accurate descriptions of a rattan species (which he shows to be the true source of the famed 'Dragon's blood') and of two Javan orchids. The orchids were, after his directions, very well drawn by F. W. BRANDHAGEN. In general, it may be said that KAEMPFER's work demonstrates with clarity the advantage of composing descriptions on the spot, i.e. while staying in the East, and with the living plant growing in its natural surroundings at hand. The superiority of the descriptions of a phytophrapher working in daily touch with his subjects will be further stressed in paragraphs 19-21. For the moment the studies by J. BANKS (1) and by T. NAKAI (2), based on KAEMPFER's specimens and drawings, may be noted.

*References:* (1) BANKS, *Icones selectae plantarum &c.* (1791). (2) Journ. Arn. Arb. 6 (1925) 186-189.

## 13. Visiting plant amateurs in Dutch service

In the year of KAEMPFER's return another incidental, and decidedly lesser, student of botany sailed for Europe: F. VALENTIJS, a Dutch minister

of the faith. His course of life was not favourable nor does he impress one favourably as a person. He stayed several years at Ambon (together with RUMPHIUS). His repute as a historian rests on his *Oud en Nieuw Oost-Indiën*, an encyclopedial work in a swollen, stuffy and, usually, tedious style appearing in 5 volumes from 1724–1726. The first half of the third volume (1726) deals with the natural history, mainly of the Moluccas, being drafted from facts, and copied from drawings, supplied by RUMPHIUS who, in return, is scarcely mentioned. The work is one of the rare sources of information on local affairs in remote islands at that period, reported by an eye-witness. Incidental details of some value are included when plants or plant-growth are discussed. Acknowledgment for this contribution to Malaysian plant description should go to RUMPHIUS, whose manuscripts were kept waiting to go to the press.

Sometimes the 17th and 18th century habit of publishing one's life and adventures after some experience overseas has added to botany but, of course, to a very limited extent. Among those whose writings yield some points of interest may be noted C. DE BRUYN, who in his *Reizen* (1714), offered some descriptive notes; his book makes pleasant reading. E. C. BARCHEWITZ, who arrived in 1711 at Batavia, held the command of the islet of Leti (Lesser Sunda Islands) during 6 years, and wrote a charming book with commentary to more than 40 easily identifiable plants, all first records from the island, and some appearing for the first time in print (1). Dozens of accounts of this nature remain to be studied. A French surgeon in Dutch service who published his phytophany in England was L. GARCIN. In the service of the East India Company, he sailed between 1720 and 1729 three times to Java. He wrote two articles in the Royal Society's 'Philosophical Transactions' (1730 and 1734) of phytophographical interest, on *Biophytum* ('Oxyoides'), *Musa* and Mangosteen (*Garcinia mangostana* L.).

References: (1) BARCHEWITZ, Der Edlen Ost-Indian. Comp. &c. (1730).

#### 14. English scholars: Morison, Ray, Plukenet, and Petiver

The second half of the 17th century in England shows developments of equal importance to those in Holland; the course of political history implied that plants from Malaysia were there only occasionally considered but, if incidentally, many species either common to the Deccan Peninsula and Malaysia or purely Malaysian were described, or previous data changed or improved.

ROBERT MORISON, born in 1620 at Aberdeen, studied botany at Paris and went in 1660 to England. Among several honourable appointments, he received the Professorship of Botany at Oxford (1669), where he published *Plantarum Historia Universalis Oxoniensis* (1672). In 1699, sixteen years after his death, the third part of his work was printed; it contained records of *Hortus Malabaricus* (§ 20).

To much greater fame came the work of JOHN RAY (he has been styled as the greatest botanist of his time in Europe), author of the classic *Historia Plantarum generalis*.

Born at Black Notley (Essex), after an outstanding career at Cambridge University, he travelled through the greater part of the Continent. Both the earlier volumes of his *Historia* (1686 and 1688) are only slightly less important to Malaysian phytophany than the supplementary third volume of 1704. It is probable that RAY, although his astounding knowledge and industry would have induced him to take an active part in the description and classification of Indian plants, deferred tropical botany to some extent to specialized collaborators and friends. SHERARD, while helping to prepare the last volume for the press, certainly paid personal attention to the careful interpretation of *Hortus Malabaricus*; there was also T. ROBINSON, a surgeon and his 'Amicorum alpha', who had published some brief reviews of the great *Hortus*, that basic work of early Indian phytophany which held in particular the attention of British botanists till the present day, and which I intend to discuss below (§ 20).

A friend of RAY's, and later an embittered adversary of PETIVER's, was L. PLUKENET. He was born in 1642 but did not publish before 1691, when in rapid succession his grand series of pictures, the *Phytographia* (containing the earliest picture of *Nepenthes*) began to appear; these were figures of plants in small but generally adequate cuts representing c. 8000, chiefly exotic species, among which many from Malaysia. This was completed in 1696 but in the same year a kind of catalogue to his plates, *Almagestum Botanicum Mantissa*, appeared and was completed in 1700. His final illustrated book, containing more than 2500 figures, appeared in 1705: *Amalthemum Botanicum*. He died in the same year having held a Royal professorship at Hampton Court. All his works are of considerable importance to Malaysian phytophany; his Herbarium rests in the British Museum.

A third contributor to Malaysian botany was the critical and active worker JACOB PETIVER. He showed an absorbing interest for exotic plants and, like CLUSIUS and LINNAEUS, prompted captains and surgeons sailing for the tropics to send him dried plants and prepared printed directions for them. Most fruitful were the collections by S. BROWN(E) who forwarded eight 'books' of herbarium from the Madras region. PETIVER gave an account in several volumes of the 'Philosophical Transactions' (1700–1704), preceded by a first letter to BROWN published in 1698. Many pharmacological, ecological, and systematical notes accompany the names and descriptions, while reference is made to *Hortus Malabaricus* and much other literature. It would seem that PLUKENET also studied part of these materials; several times HERMANN is mentioned as having sent plants, and so are many others. This series of papers is full of historical data and deserves a thorough study both in connexion with the developments of British Indian botany and, to a lesser extent, that of Malaysia.



Of PETIVER's other works I mention his *Plantae rariores* added as a supplement to RAY's *Historia*, 3rd volume (1704). Two years earlier appeared his *Gazophylacii naturae* in which he gave also a number of pictures of Philippine plants, possibly based on specimens from or drawings by KAMEL (cf. § 24). Another noteworthy publication was *Musei Petiverani centuriae decem* (1692–1703).

#### 15. English visiting plant amateurs

Among the diligent collectors who by their unselfish efforts built the material base of Malaysian phytophraphy, JAMES CUN(N)INGHAM(E) ought to be remembered. He sent RAY, and in particular PLUKENET and PETIVER, several species of Malaysian plants; his course of life and the stations where he, sometime surgeon at Amoy in China (1698), collected are not sufficiently known. He secured some specimens when staying at Batavia, probably also on his two days' visit to, and later on his prolonged residence on, the western coast of Borneo and his sojourn on Pulo Condor (c. 1705).

WILLIAM DAMPIER, commander of an English man-of-war and buccaneer, sighted New Guinea on January 1st, 1700. Touching at Ceram and Timor, he reached Batavia. He repeatedly visited the Archipelago, but only on the first voyage drawings, proving an exceptionally able hand, seem to have been made. His notes on the vegetation, his pictures (he stated that one of his shipmates made them, but probably this is modesty), and the herbarium specimens he brought to England give him a right to be remembered as a contributor to Malaysian phytophraphy (1).

Finally I mention ALEXANDER BROWN, as an important collector of Cape and Indian plants.

*References:* (1) DAMPIER, *A New Voyage Round the World*, ed. Hakluyt (1927), also LEE, *Early explorers in Australia* (1925).

#### 16. English botanical gardens

The cultivation of tropical plants in England was no less advanced than in Holland, which aided the study of Malaysian plants in a similar manner. There was for example the flowering of *Carica papaya* L., much to the satisfaction of SHERARD (§ 10), who in the summer of 1701 was able to prove the correctness of the drawings in *Hortus Malabaricus* by this fresh material. Since LINSCHOTEN's first note (§ 7) and CLUSIUS's (§ 9) close description (2), *Carica* had roused much interest as an instance of morphologically clearly different males and females. PLUKENET cultivated *Dioscorea bulbifera* L. at Hampton Court. Gardeners of European fame who sometimes published their results (1) were e.g. J. GORDON and PH. and J. F. MILLER, father and son, who successively tended the 'Physick Garden' at Chelsea. The finest result of botanical work of this nature is perhaps the set of coloured plates (1750–1773) by G. D. EHRET, the *Plantae selectae* (cf. § 17).

*References:* (1) MILLER, *The Gardener's dictionary* (1731). (2) CLUSIUS, *Curae post.* (1611) 78–81.

#### 17. Linnaeus and his work in Holland

The rising star of CARL VON LINNÉ commanded more and more the attention of the botanists of Europe about 1735 when he, having graduated at Harderwijk University, stayed with J. BURMAN at Amsterdam. He was a young man, 28 years of age and keen to extend his practical experience. The exceptionally fine Herbarium of his host made him postpone his return to his native country, Sweden. The manuscripts of RUMPHIUS and the plants from Ceylon (cf. §§ 10–21), attracted him and at the Amsterdam 'Hortus Medicus' he was soon counted among the faithful visitors. Meeting him there, GEORGE CLIFFORT invited him to inspect his private collection at his country seat near Haarlem, and the bait was taken; LINNAEUS became botanist of the 'Hartecamp'. Of tropical Asiatic plants were present cloves, mangosteens, cocos and other palms, *Cassia*, *Acacia*, *Tamarindus*, pepper, *Annona*, and *Musa*. A good museum and library formed a worthy setting for this gem of 18th century science. In January 1736, *Musa* flowered for the first time in Holland (*Musa Cliffortiana*, 1736).

In the same year, LINNAEUS published *Bibliotheca botanica*, which was twice reissued (1747 and 1751) and is a guide to early phytophraphy, also as regards Malaysia. After a brief visit to England he returned and wrote *Hortus Cliffortianus* (1737), a shining proof of LINNAEUS's ability and CLIFFORT's munificence; many East Indian plants were treated. The book was illustrated by G. D. EHRET, a young draughtsman of LINNAEUS's age and his devoted pupil whom he met when arriving at the 'Hartecamp', and whose extraordinary gift for drawing flowers found a happy expression in applying the Linnean doctrines in his illustrations. After LINNAEUS's return to Sweden, EHRET went to England where his work was greatly appreciated as has been indicated above (§ 16). Sir JOSEPH BANKS, after his death, acquired many of his drawings which were finally deposited in the British Museum.

#### 18. Flora Zeylanica

In Sweden LINNAEUS wrote his only work devoted solely to Indian plants: *Flora Zeylanica*, in 1747. The immediate cause was the rediscovery of 4 volumes of HERMANN's Herbarium; these served as a keystone to the work (cf. § 10).

H. TRIMEN demonstrated (1) that the nomenclatural importance of the work lies in the subsequent quotation of all entries in the *Species Plantarum* of 1753; the text of the book typifies many names. A second identical edition followed in 1748. LINNAEUS believed the Javan flora to be the same as that of Ceylon; the theory that the tropics were inhabited by an identical flora in all parts was held by leading botanists long after him. *Flora Zeylanica* had not been drafted according to a binomial system. Applying his artificial classification, LINNAEUS analysed 397 species. Another 31 he indicated as 'obscurae', that is plants of which the fructification was as yet insufficiently known; 13





W. H. BROWN



BURCK



BURKILL



BURRET

further numbers were occupied by plants without any fructification ('dubiae'), and a section was somewhat disparagingly kept apart as 'barbarae' (plants of which HERMANN noted the name but did not preserve dried specimens). Yet, LINNAEUS enumerated them with all available data hoping that others would investigate. It may humour the modern systematist to meet LINNAEUS in a pre-Linnean period looking for type specimens to 129 numbers of 'barbarae'. A group of 'annihilatae' he considered to be rejectable. Fourteen pages, separately numbered, contain 30 new genera of Cingalese plants proposed by S. M. DASSAW, one of LINNAEUS's pupils, among which *Pavetta*, *Cissus*, *Mimusops*, *Memecylon*, *Connarus*, *Indigofera*, and

*Sterculia*, all to be included in *Species Plantarum*; several had been taken from earlier work, e.g. from J. BURMAN. It is stated by TRIMEN that 591 species of HERMANN's Herbarium were described and included by LINNAEUS, eight additional species though present as dried specimens were not published. A good deal of the main set are found also in Malaysia.

I must abstain from discussing the by no means negligible achievements in France and various other parts of Europe, and confine myself to a general outline of the most obvious aspects of pre-Linnean phytography outside Malaysia.

References: (1) Journ. Linn. Soc. Bot. 24 (1887) 129-135.

## PRE-LINNEAN PHYTOGRAPHY IN TROPICAL ASIA AND MALAYSIA

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### 19. The foundations of phytography in Malaysia

In contrast with the dozens of botanical publications in Europe describing Malaysian plants in large or small numbers, only a few books were written in the Indies, these latter demonstrating, however, a truth that could be confirmed again and again in the course of history: the great advantage to the phytographer of working on the spot i.e. in daily contact with his living subject in its natural surroundings. Two pre-Linnean books form the foundation of all phytography of the region; their qualities are so convincing that they were, on appearing, immediately acknowledged to be authoritative, and they maintained their pre-eminent place to the present day as sources of reliable information. These are *Hortus Malabaricus* and *Herbarium Amboinense*.

### 20. Hortus Malabaricus

The main directive power in composing *Hortus*

*Malabaricus* was H. A. VAN R(H)EEDE TOT(VAN) DRAA(C)KE(N)STEYN. In 1637 he was born at Draakesteyn Castle, near Utrecht, and after an adventurous but prosperous career in the Dutch East India Company was appointed Governor of the territory of Malabar (1669). Some not quite explained difficulties caused his return to Europe (1677), where he devoted much of his time in supervising—together with learned gentlemen at Leyden—the edition of the botanical work written during his term of office. In 1684 he was again sent to the Indies on an important auditing commission but, in the middle of his task, died in 1691.

This short biography suggests no scientific training and RHEEDE himself stated his inexperience as a botanist candidly. Nevertheless, he must have been an exceptionally good observer because, while his contemporaries scarcely noticed more component parts of the tropical vegetation than, as a rule, some variety of edible fruit, RHEEDE noted: (transl.) "I observed on my travels the extraordinary diversity of the trees . . . so that it

would be difficult to obtain two trees of the same kind in one forest; I saw trees girdled and covered by other plants, while others . . . with the tree they were covering, were confounded until they could hardly be distinguished; I noticed often also, speaking in comparison, numerous ivies of different kinds clinging to one tree, and besides many growing into the very branches of the trees, and on the foot of the trunk other and still other plants forming a most attractive spectacle, and on one single tree ten or twelve different sorts of leaves, flowers, and fruits might be met with."

Here, for the first time, a man who was not overwhelmed by the welter of luxuriant green of the tropical vegetation, but one who analysed and defined its components, discerning both the structure of the whole and the variety of its details. So far, explorers had been repelled and daunted by the wild primeval forests; now they were discovered to offer a 'most attractive spectacle'; here lies the mainspring to RHEEDE's achievement.

RHEEDE, with all his interest in botany, knew his limitations and wanted assistance but, on the Kuching coasts of India, where he resided as Governor, trained botanists were rare. Becoming acquainted with a Neapolitan Carmelite missionary, Father MATTHEUS (PIETRO FOGLIA or MATTEO DI S. GIUSEPPE), he found that this roving priest had occupied himself a long time with the flora of the region. He had collected and made many notes and drawings. RHEEDE's aim, from the beginning, was to attempt a description of all species of the territory, and he set out with MATTHEUS for the great task. MATTHEUS's data proved not wholly satisfactory; his dried specimens were not always suitable for an adequate picture—this lack naturally became the more apparent when the living plant was at hand and could be compared; and his drawings were not quite clear in certain details. MATTHEUS and RHEEDE went out together to hunt for better samples but MATTHEUS, well past fifty, had lost much of his agility and the Governor, much the younger but fond of a good life, scarcely proved a better collector. At this time, HERMANN passed some weeks at Kuching and was asked for advice. For a moment it was considered to put all materials into his able hands but HERMANN declined and, while the pair of bold amateurs availed themselves of his help as long as he would stay, it was decided to look for other assistance. JOHANNES CASEARIUS was invited to join forces.

CASEARIUS was a Reformed Church minister, officiating on behalf of the East India Company at Kuching (1675–1677), who loved plants but was scarcely better equipped for scientific botanical work than RHEEDE and MATTHEUS; he has been described as 'a man most versed in all learning, if only Botany was excepted'. He had, however, command of Latin and might be expected to translate the texts into good erudite language; CASEARIUS thus wrote the Latin version of the first two volumes of *Hortus Malabaricus*. Shortly before CASEARIUS began work, RHEEDE ordered (1674) the learned Brahmins RANGA BOTTO, VINAIQUE PANDITO (the Pandit Vinaus?) and APU BOTTO to as-

semble all plants contained in the ancient work *Manhaningattñam* and to add all they knew about these. HERMANN's counsel may be readily divined in this change of policy: *Hortus Malabaricus* now was placed on the scientifically most favourable base that could be procured, a book representative



RHEEDE

of old local learning and on an accumulation, interpretation, and revision of all available data gathered by men who might be regarded as best informed. Another specialist was added to this Staff, ITTI ACHUDEM, a native Pegu physician, who was bidden to Malabar, contributed many native plant names, and taught the reputed medicinal virtues of certain species.

These initial steps towards a 'complete' flora took nearly two years. Then, confronted with the reality of the immense task of composing a book of this scope—one understands the size and endless variety of the tropical Asiatic flora only gradually as experience and knowledge grow—RHEEDE felt that *Hortus Malabaricus* required a still larger Staff.

Four native draughtsmen, for this special purpose in his service, now accompanied him on his trips (though the final work contains a number of drawings made after MATTHEUS's originals), a body of fifteen or sixteen Brahmin naturalists and physicians drafted descriptions; in addition, all native princes and chiefs in the territory had been asked for help. Collectors went out, instructed to search for specimens in flower or fruit; many first sketches were done on the spot to be perfected at home, and hundreds of samples arrived which were classified, studied, and delineated by word and pencil. The Governor, swamped by materials, sighed: "often were more plants roughly outlined in one day than could be drawn and described in

several months by the draughtsmen and CASEARIUS".

After CASEARIUS, fallen ill, had left (he died 1678 at Batavia), the Latin translation was entrusted to CHR. H. DE DONEP (or VAN DOUET), who for his work used the Portuguese version by E. CARNEIRO, the latter having in his turn received the text in the vernacular of Malabar, written by COLADDA, another Pegu physician, the teacher of ITTI ACHUDEM. There was also, at some stages, help from the able WILLEM TEN RHIJNE, repeated afterwards in Holland during the printing of the first two volumes. Whether he aided as substantially as PETIVER believed (1), remains to be decided.

When the differences in training and scientific standing among the numerous collaborators in this early instance of team work are realized, apart from the necessary and repeated translations by interpreters unschooled in natural sciences, the results are amazing and are to be understood only if the skill of the editors in Holland is recognized.

RHEEDE began to send manuscripts and illustrations asking the Leyden scientists to keep these till the whole work could be completed and suitably arranged; owing to enthusiasm, it may well be supposed, printing started without delay. ARNOLD SEYEN (or SYEN), Professor in Leyden University, presented the first volume on May 8th, 1678, to the Board, having added to the text notes partly supplied by HERMANN in letters from Ceylon; it was published in the same year. SEYEN died and was succeeded by J. COMMELIJN, who edited the descriptions and attended to the publication till, in 1703, the 12th volume brought the *Hortus* to an end.

Other co-editors were J. MUNNICKS (vol. 2-5), T. J. VAN ALMELOVEEN (vol. 6), and A. VAN POOT (vol. 7-12). The entire work contains 784 plates and descriptions.

The *Hortus Malabaricus* attracted the attention of all the learned world; its early publication, numerous first records, and wealth of new facts made it hold the interest of Indian and Malaysian botanists ever since. Originally a separate Dutch version was intended but a translation of the first two volumes only came from the press (1688 or 1689), reissued with a changed frontispiece in 1720. J. HILL made an English edition and added a Linnean *Index* in 1774.

The identification according to modern systematics of the species under discussion has been thwarted by the absence of dried specimens; as far as is known RHEEDE sent no herbarium to Europe, though he forwarded living plants from Ceylon and Malabar to the Amsterdam 'Hortus Medicus'; he also cultivated many species dealt with in *Hortus Malabaricus* in his residential garden at Kuching. Although there has been made no thorough search for authentic specimens of RHEEDE's, it is doubtful whether the discovery of some specimens would do more than confirm what is known and be more than a historically interesting find. The interpretation of the species is, if based only on description and plate, in but a few cases impossible or uncertain, the majority having been pictured and described with unmistakable clarity.

The arrangement of the plants in the several volumes is, partly due to their premature issue, somewhat disordered and, considering the period of their publication, decidedly primitive. The Theophrastan division of the vegetable world into trees, shrubs, and herbs is followed and even that not strictly. Typically pre-Linnean traits may be noticed e.g. *Caesalpinia pulcherrima* Sw. (2) is meticulously drawn and very closely described but in the drawing not a single flower shows the correct number of stamens. A separate (7th) volume is—much to the taste of the day—devoted to woody climbers.

C. COMMELIJN was first in attempting to create order by publishing a catalogue and index to part of the work in 1696 (cf. § 11). This *Horti malabarici catalogus* contains an important bibliography of early Indian botany and RHEEDE's names are reduced and made conform to the existing scientific literature. In 1769, J. BURMAN made another *Index* in accordance with LINNAEUS's *Species Plantarum*. A. W. DENNSTEDT wrote a key in 1818 (3).

The first critical study and interpretation was written by F. BUCHANAN-HAMILTON, Director of the Calcutta Botanic Gardens (1814-1815) but printing was discontinued in 1837 when but three volumes had been dealt with (4). BUCHANAN's entire manuscript is in possession of the Linnean Society of London, and a similar, also partly published, study of the 'Herbarium Amboinense' (see later) is in manuscript owned by the Wernerian Society of Edinburgh. J. K. HASSKARL (§ 53) made elaborate but not entirely successful interpretations in 1861, 1862 and, finally, in 1867. A new interpretation of *Hortus Malabaricus*, I am told, is now kept in provisional manuscript by Dr A. H. G. ALSTON.

*References:* (1) Philol. Trans. 20 (1698) 331. (2) Hort. Mal. 6, p. 1. (3) DENNSTEDT, Schlüssel zum Hort. Ind. Mal. (1818). (4) Trans. Linn. Soc. London (1822-1837); for other lit. on RHEEDE cf. VETH in De Gids (1887); SIRKS, Ind. Nat. Ond. (1915).

## 21. *Herbarium Amboinense*

While the *Hortus Malabaricus* was being composed as the foundation of all post-Linnean western Malaysian botany, there lived and worked in the lonely most eastern outpost of European enterprise, the Moluccas, another botanist, G. E. RUMPF, whose *Herbarium Amboinense* made a perfect footing to all modern knowledge of the eastern Malaysian vegetation (1). If RHEEDE and his collaborators had at their command all material and official support, all transport and other facilities they could wish for, RUMPF, though a man of notable standing and better education, needed the consent of many superiors for his plans and activities and was repeatedly cruelly hit by adversities of fate. *Hortus Malabaricus* is a fine testimony of industry, ability, and progressive endeavour but *Herbarium Amboinense* a proof of a never abating fervour for scientific botanical studies, of amazing skill combined with such a devotion to botany as is very rarely found; it is a work of genius.



A. P. DE CANDOLLE



AUG. DE CANDOLLE



CAS. DE CANDOLLE



CLARKE

GEORG EVERHARD RUMPF, better known as RUMPHIUS, was born in 1628, probably at Hanau on the Main, ancient town with a population half of German and half of Dutch stock. His early life's adventures (for a fuller account see *Rumphius Gedenkboek* 1902) brought him to Portugal, from where he returned with the resolution to study the wonders of tropical nature. In 1652, having enlisted in the service of the Dutch East India Company, he left for the East never to see his native country again. He had given his christian name as 'Jeuriaen' which has induced one of his biographers to raise the question whether he had reason to cover his identity; I wish to offer the happy explanation that 'Jeuriaen' is nothing but the low-Dutch diminutive for 'Georg', and probably the name by which he was known. The supposed adoption of this name now obtains quite another aspect; could it possibly indicate a closer affinity to the Dutch than would appear from his family name and so explain, perhaps, why RUMPHIUS wrote a Dutch prose of remarkably good quality with no trace of German idiom and why he, in his plant descriptions, had non-technical Dutch words at his command which pictured to perfection the plant-characteristics he wished to define?

About the middle of 1653 he landed at Batavia, soon to continue his way to Hoamohel, an islet near Amboina, where he remained (1654). Military service held him till 1657, when he was appointed as a 'second merchant', at Larika, in the north of Amboina. In 1660 he was promoted to 'Chief' (Op-perhoofd) of the whole of the northern peninsula Hitoë, and again, in 1662, to 'first merchant'.

Being now a man of note and repute, who received a good income, he found leisure for his coveted research. Some proof of his ability had been the design of the fortification at Banda and he now wrote to the Directors of the Company announcing his intention to write a 'work wherein will be described in Latin such plants, herbs, animals etc. as he has come across and still will meet with during his time of residence in the Indies'.

In 1666, a small botanical garden near the City Hall at Ambon, provided an opportunity of introducing desirable plants and of keeping for study others in close proximity. More and more absorbed in his pursuit of natural sciences, he wanted to

resign at the expiration of his contract (1667); his official work was 'a mask I am compelled to wear in order to secure a daily living for myself and my family'.

His request to be allowed to stay another 8 months in the island as a private citizen was, according to the strict regulation of the day, refused but a reasonable solution to the problem was proposed and accepted: he was to remain another year in the service of the Company and not to be forced to leave Amboina during that period. It was understood that he continued his studies to such an extent that the interests of the Company did not suffer; on these conditions RUMPHIUS remained at Ambon.

The Ambonese herbal must have progressed rapidly but not fast enough: in April, 1670, RUMPHIUS became blind. Minor officials dismissed him, disabled, on the instant but an appeal to Governor General J. MAETSUYCKER was successful and RUMPHIUS was replaced in 1671 in all his former functions and dignities without reserve. A very satisfactory report on the fortress 'Victoria' to the High Government, a work that must have been made at considerable pains, may tacitly testify to his gratefulness; the *Herbarium Amboinense* seemed safe.

In 1674, a violent earthquake destroyed his house, killing his wife and daughter, but grief again failed to stop his ceaseless activities. While perfecting his herbal, he wrote a historical-topographical work on Amboina, an advice on Agriculture and several other papers, listed by ROUFFAER and MULLER (1).

Gradually the botanical work of RUMPHIUS received wider attention. He corresponded on botanical matters with H. DE JAGER A. CLEYER W. TEN RHIJNE, CHR. MENZEL and others; the *Academia Naturae Curiosorum* at Nurnberg appointed him as a member (1681). Many of his letters have been incorporated in the third volume of *Natur- und Materialienkammer* (1704) by M. B. VALENTINIUS, Professor in the University of Giessen.

A new calamity befell him. In the great fire of Ambon (1687) perished his books, collections, drawings, and manuscripts (among these a written key to the first two volumes of *Hortus Malabaricus* and an interpretation of BONTIUS, cf. § 22); a most

fortunate precaution made it possible to replace the manuscripts by means of copies stored elsewhere but all original drawings were irretrievably lost, his blindness preventing him from making new ones by his own hand.



RUMPHIUS

The coloured plates, kept at Batavia till 1692, were copied by C. ABRAMSEN, a personal servant and pupil of RUMPHIUS's who also drew plants to the satisfaction of Governor General CAMPHUYS and of CLEYER. The plates made under RUMPHIUS's own direction—it was at first intended to illustrate the *Herbarium Amboinense* with coloured drawings—went down on the voyage to Holland with the 'Waterland', but ABRAMSEN's copies reached port and are preserved in the Amsterdam University Library. The illustrations in the *Herbarium Amboinense*, having never been corrected by RUMPHIUS's own critical inspection, are of lesser weight than the descriptions which are authentic; nevertheless the figures have proved to be generally trustworthy.

The losses were practically repaired mainly by

'hij wast op de manier als den Calappus-Boom, dog den stam is wat dikker, maar ook veel lager, en qualyk zoo hoog als een Pinang-Boom, bij de wortel effen, en geentsins uitpuilende, zynde met zyn zwart-groen looff, wilt en droevig in 't aanzien, ook ligt van andere Boomen te onderkennen: den stam is mede eenigszins in trappen verdeelt, doch zeer oneffen en ruig van mosch, als mede met veelderley soorten van Vaaren en *Polypodium* zoodanig bewasschen en bedekt, dat men hem qualyk herkennen kan, voor en al eer hy van de Tieffadoors gezuivert wert; zoo dat hij met zyn leelyke en wilde gestalte niet qualyk een dronken Boer gelijkt, zoo als die met zyn gelapte klederen, en verwarde hai-

the unwavering perseverance of RUMPHIUS, also by the help of friends. The 'Lords XVII', Court of Directors of the Honourable Company, allowed him another assistant.

In 1690, the first 6 books of the *Herbarium* were shipped to Batavia, and dispatched (1692) to Holland by the unfortunate 'Waterland', which was attacked and sunk. CAMPHUYS, a man of considerable merit in many fields of Malaysian botany, had had copied the manuscripts and so, in 1696, a MS. of the lost 6 books together with 3 further books sailed for Holland to reach their destination safely. In the course of 1697, the 3 concluding books followed. An *Auctuarium*, or supplement to *Herbarium Amboinense*, reached Holland in 1704, and was published as the 7th volume. It was his final work. RUMPHIUS died, 75 years old in 1702 at Amboin. In Malaysia his work, as a whole, has never been surpassed and, in part, rarely equalled. His character and work deserve the many highly admiring and enthusiastic biographies by e.g. LEUPE (2), HENSCHEL (3), HEERES (4), HARTING (5), SIRKS (6), and BALLINTJN (7).

When RUMPHIUS, in 1663, began to write in earnest it was, perhaps, not entirely a disadvantage that he had few books at his disposal. The Company gave free transport for books purchased for him by RULICIUS, a divine at Amsterdam, but these were not many. The scarcity of works of reference will have stimulated him to use his own resources: his sound judgment, his eyes, hands, taste, and talent for description, and it promoted a closer contact with his plants. This poor equipment from a scholar's point of view may have materially contributed to the everlasting freshness of an excellent observer who, forced to find terms in composing his descriptions, coined his phrases without restraint and so wrote, being a man with a lively sense of humour, critical mind, and unremitting urge to investigate, a book which now, after more than two and a half centuries, is a joy to read and an inexhaustive source of good information.

Familiarity with Rumphian style and expression adds substantially to the appreciation of the Malaysian flora; when meeting with plants described in *Herbarium Amboinense* one is pleasurably excited on recalling his pen-portraits which, many times, by some master stroke, picture them vividly and true to life. This is a portion of the article on *Arenga pinnata* (WURMB) MERR. (Herb. Amb. I, p. 57):

(transl.) "He grows in the manner of the Coconut Tree, but the trunk is somewhat stouter, also much lower and hardly exceeding the Pinang Tree, smooth near the roots and not at all bulging, being in its black-green foliage wildly and sombrely attired, also easily distinguished from other trees: the trunk is, in addition, slightly transversely ribbed and not only very uneven, and rough with mosses, but also so much overgrown and covered by a variety of Fern and *Polypodium* that he is scarcely recognisable before being cleaned by the gardeners; which makes him seem a drunken peasant, as he leaps from his sleep in his patched clothes and ruffled hairs; verily, it is the least attractive among

ren, uit den slaap opspringt; immers het is de leelykste van gedaante onder alle Boomen. De takken staan bij malkander boven in den top, gelyk die van den Calappus-Boom, dog hier en daar hangt er een oude by den stam af: zy zyn vyfthien en zeventien voeten langk, styver en ruiger dan den Calappus-takken, niet uitgeholt, maar hoekig, en zonder eenige doornen aan de kanten, te weder zyden met breede bladeren bezet, gelyk die van den Calappus-Boom, dog grooter, te weten vier vingers breed, en vier voeten langk, wel te verstaan omtrent het midden van de tak; want aan beide eynden worden ze allengskens korter, voor met een breede stompe spitze, als afgebroken, of in mindere spitzten verdeelt, en het alder-voorste is het alderkortste, breedste, en driezijdig; haare randen zyn bezet met weinige ydele en subtile doorntjes, doorgaans aan de oude bladeren, en hangen de meeste nederwaarts omtrent de midden afgebroken, en door malkander verwert, aan de bovenste zyde glat, donker of zwart-groen, van onderen gryns of witachtig."

Apart from the picturesque and fitting comparison of the appearance of *Arenga pinnata* with that of a drunken 17th century peasant, it is to be observed how skilfully RUMPHIUS describes the general habit of this palm by contrasting it with a related 'tree', how he does not even omit to point to the swollen base of the Cocos Palm which is

"Het bloeizel komt voort aan groote en uitgebreide trossen, daar aan ziet men groote bloemen, in de gedaante van violen, doch grooter, yder op een groen lank steeltje, niet gedrongen, maar ydel van malkander staande, doch die evenwel door haar swaarte den tros wat nederbuigen, zynde yder gemaakt van 5 geele blaatzjes, waar van de drie onderste uitwaarts geboogen hangen, de bovenste zijn bultig, en inwaarts gekromt en daar binnen staan verscheidene groenachtige en lange draaden, ook een weinig gekromt met grauwe noppen, waarvan er vier buiten de bloem uitsteeken en van dezelve is de middelste nog langer, dikker, en groender, dan de andere, als een zikkel gekromt, en zonder nop, waar uit de vrucht voortkomt, zo dat uit een bloem maar een vrucht, of houwe groeit, en niet twee of meer, gelyk zommige gemeent hebben, hoewel de meeste part van de bloemen tot vruchten werden, en weinige komen af te vallen."

This quotation has similar—and other—qualities as have been indicated above. It was not easy to compare a *Cassia* flower to a well-known allied flower; *Caesalpinieaceae* do not occur in northern Europe, nor are there related species in Amboina familiar to every botanist. To select a violet for the purpose is surprisingly and admirably suitable.

The following words of GREENE (8) illustrate my meaning: "If the born botanist—not the machine made one—write of plants he will find language wherewith to enable his readers to see what he has seen in a plant; and this is phytophraphy."

RUMPHIUS had several assistants, all of them untrained in botanical matters when they entered

all trees. The branches are placed together at the top, like those of the Coconut Tree, but here and there an old one hangs down the trunk: they are fifteen and seventeen ft long, stiffer and rougher than the Coconut branches, not furrowed, but angular, and without any spines on the edges, on both sides bearing broad leaves in the manner of the Coconut Tree, but larger, that is four inches wide and four feet long, to be sure about the middle of a branch; because at both ends they gradually become shorter, the top with a broad blunt end, as though broken or parted in smaller tips, and the foremost is the most smallest, broadest and triangular; their margins are beset with sparse, distant, and minute spinelets, usually on the older leaves, and the majority hang downwards, broken about the middle, and confused, the upper surface being smooth, dark or black-green, the lower surface grey or whitish."

absent in *Arenga*. From the broad outline he descends into detail and, with sure instinct, notes what are important characteristics in the leaflets. This example of his art in describing vegetative organs may find its counterpart in a description of a flower, chosen at random. He says concerning *Cassia fistula* L. (Herb. Amb. 2, p. 83):

(transl.) "This blooms in large and extended racemes, in which one sees large flowers, of the appearance of violets, but larger, each on a green slender stalk, not close together but remote, though they bend by their weight the stem somewhat downwards, each consisting of 5 yellow petals, of which the three lower are spread and bent outwards, the uppermost are bullate and bending inward, and inside there are several greenish long threads, also somewhat bent with ash-coloured knobs, of these four exerted from the flower and among these the central one still longer, thicker, and greener than the others, curving like a sickle, and without knob, out of this latter comes forth the fruit, so that from one flower grows one fruit, or *siliqua*, and not two or more, although the majority of the flowers set fruit, and a few are shed."

his service. Ablest of all was PAUL AUGUST (died 1705), his son, who made a number of the most successful drawings. CHR. GIERAARDS (or GERARDE) accompanied him often on collecting trips (before 1691); in 1680 he was temporarily helped by D. CRUL. Of great support to the blind RUMPHIUS was a sailor boy and draughtsman, PHILIPS VAN EYCK (1688–1696). J. PH. SIPMAN wrote part of the text of the *Rariteikamer* (1705) and collected himself; he was possibly the best of his servants. Dr VAN STEENIS, in Nov. 1946, examined a volume of SIPMAN's plants among KIGGELAER's specimens in the British Museum (Herbarium Sloane 220, vol. VIII); apparently not all are Ambonese. J. HOOGER-





COGNIAUX



CORNER



DANSER



DECAISNE

BOOM made drawings for RUMPHIUS in 1685; P. DE RUYTER, a talented soldier schooled by VAN EYCK before he left Amboina (1696), perhaps remained at Ambon till RUMPHIUS's death.

In 1700 the Directors of the East India Company were approached with a request to release the manuscript for publication. There is ample evidence that the scientific value of RUMPHIUS's book was recognized and, also by the Company, was appreciated but it contained jealously guarded trade secrets. The carefulness with which it was prevented that data concerning spices would spread is illustrated by the fact that in 1685 only one nutmeg tree, closely supervised, was kept at Batavia by a special privilege.

Soon, the desire for scientific enlightenment prevailed and, in 1702, publication was consented to, with some slight restrictions. For some reason, I am not certain which, printing was further delayed until, in 1736, J. BURMAN acquired the manuscript. He added short notes and prepared it for the press. Between 1741 and 1750, the 6 volumes appeared; the *Auctuarium* followed in 1755. BURMAN's editing work was good. There exist some discrepancies with the manuscript which may form the subject of a botanico-historical study.

Only the *Auctuarium* (1755) is to be considered in matters of nomenclature. RUMPHIUS wrote long before the binomial system had been brought to some perfection by LINNAEUS; his work, with all its sterling qualities, is essentially pre-Linnean in style and execution. Rumphian plant names could never be admitted under rules based on the Linnean binomial technique but, as many modern names are typified by pre-Linnean phytophographical publications, Malaysia is fortunate in having the *Herbarium Amboinense* for its part.

The whole work contains more than a thousand species, 1660 pages of letterpress and 696 plates. Taxonomically, the structure of the book is crude though it cannot be denied a logical sequence adapted to practice. In the first place, the ancient division into trees, shrubs, and herbs is roughly followed; further, the plant is considered in its relation to man on a utilitarian principle, and finally it is skilfully attempted to explain to the reader which plant is under discussion by contrasting it against related species and comparing it to com-

monly known kinds. Although Moluccan, and among these Ambonese, plants are the very large majority, the *Herbarium Amboinense* by no means deals only with those nor is it a complete Ambonese flora.

C. B. ROBINSON (9) counted the references made to the several regions outside Amboina. From many, I cite: 125 entries from Java, from Celebes 83, Ceram 77, Bali 74, Philippines 20, Borneo 8, Sumatra 8, New Guinea 4. These figures are interesting especially when considered in comparison with the state of botanical knowledge of those regions at present.

MERRILL, who wrote the best commentary (9) to the work (1917), said that all Rumphian plants were lost and that interpretation of the species therefore had always to be based on the descriptions, and to some extent on the drawings. Generally speaking, this is true but there is, on the other hand, a certainty that at least some Rumphian plants may be traced (10). PETIVER, and also RAY, have owned plants sent by RUMPHIUS and there are other possibilities. As is the case with *Hortus Malabaricus*, the time required in tracing specimens which have been in his hands would probably, from a scientific point of view, be largely lost; some scattered specimens most likely would add little or nothing to what is known already, but it may be assumed to be a point of duty to locate at least some material originating from the greatest pre-Linnean phytophographer Malaysia had.

The difference in skill and knowledge of RUMPHIUS's draughtsmen has caused differences in the quality of the drawings and sometimes also discrepancies with the text. In order to solve the various problems regarding a correct interpretation of his plants many efforts have been made. LINNAEUS, STICKMAN (11), BURMAN, LOUREIRO, and LAMARCK's are among the earliest, though some of them incidentally; of their many mistakes MERRILL (9, p. 28-29) gave some interesting cases. It may be stated that these slips appear to be due rather to a lack of material or careful research than to RUMPHIUS's writings. Two botanists of merit lost their life when trying to secure illustrative plants on the classic grounds. The first was J. G. BOERLAGE, who died from tropical fevers (1900) soon after he had arrived, and C. B. ROBINSON, who was murdered



by superstitious natives (1913) after having brought together a considerable collection. E. D. MERRILL, then in charge of the Manila Herbarium under whose auspices ROBINSON had worked, distributed his duplicates. Those assumed to represent Rumphian species, are the 'Plantae Rumphianae Amboinenses', the remainder are 'Reliquiae Robinsonianae' (13).

LINNAEUS ought to have incorporated *Herbarium Amboinense* in his *Species Plantarum*, which necessitated an interpretation after his principles. He realized this and excused himself by pretending that he did not secure a copy of the Ambonese herbal until the manuscript of *Species Plantarum* had been completed. This can hardly be true, for the whole of the *Herbarium Amboinense* had been published in 1750, the first two volumes as early as 1741. BURMAN, moreover, was preparing the manuscript for the press in 1738 when LINNAEUS spent some weeks in his home at Amsterdam. MERRILL detected only 19 references to the *Herbarium Amboinense* in the whole of *Species Plantarum* and one cannot escape the thought that LINNAEUS avoided interpreting the *Herbarium Amboinense* which cannot be explained with certainty. Many Rumphian species cannot easily be reduced to and made to fit in the Linnean system, sometimes because the descriptions lack the details required for that purpose. Possibly, an interpretation of the entire *Herbarium Amboinense* in *Species Plantarum* would have left much in the dark and have cost too much time; the result, at that moment, would have been unsatisfactory. In addition, it seems that LINNAEUS underestimated the merits of the *Herbarium Amboinense*. And it seems possible that he felt that his book on HERMANN'S Ceylon plants (§ 18), which was entirely incorporated in *Species Plantarum* gave an adequate picture of the tropical Asiatic flora, as he believed that the flora of the tropics was identical in all regions. LINNAEUS wanted some study of *Herbarium Amboinense*, however, and charged one of his pupils, O. STICKMAN, to study and identify the plants it contained; the result was a somewhat superficial and fragmentary interpretation in 1754, reprinted in 1759 in the 4th instalment of the Linnean serial *Amoenitates Academicae*. Approximately 300 of RUMPHIUS'S plants are reduced to Linnean binomials, many of them wrong. The reprint is different in that the *Auctuarium* is also considered and a number of reductions are either corrected or added, raising the total to c. 330 (MERRILL).

BURMAN published an *Index* to the whole work, according to the Linnean system in 1755, a second *Index* from his hand followed in 1769. Now 458 binomials adorned the Rumphian species. J. C. M. RADERMACHER, in his *Naamlijst* (§ 38), reduced RUMPHIUS'S plants as far as they had been assigned to Java (1781). BUCHANAN-HAMILTON also worked on the Linnean interpretation but never completed his study (1826-1832). A *Clavis Rumphiana botanica et zoologica* by A. G. E. T. HENSCHEL (1833) summarized the findings of professional botanists and added no fresh opinion in this respect. Among the numerous students of parts of the *Herbarium*

*Amboinense*—any botanist studying to some extent Malaysian plants will find occasion to refer to RUMPHIUS—C. L. BLUME deserves to be mentioned; he amply and ably discussed aspects of Rumphian discoveries in many pages of his *Rumphia* (see in particular vol 1, 1845). H. ZOLLINGER com-



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posed an incomplete key (manuscript in the Buitenzorg Herbarium). A good compilation of all literature extant augmented with data was supplied by J. E. TEYSMANN, who on his Moluccan expedition paid special attention to Rumphian plants. Another key, based on study of new materials, was made by J. K. HASSKARL (1866) but that author was not very successful in his attempts at additional reductions (12). His reasoning is not lucid and mere variants or details are overstressed. Notwithstanding these shortcomings, his efforts furthered appreciation and understanding of the *Herbarium Amboinense*.

MERRILL'S admirable *Interpretation* (9), in its concise, direct, and accurate style, is by far the most valuable study yet written (1917). He estimates that the 7 volumes contain about 1200 species, 930 of which can be referred to definite binomials; another 140 may be placed in their respective genera. Some 350 Malaysian species are now typified by Rumphian figures and descriptions.

The commemorative volume *Rumphius Gedenkboek* (1902) may be referred to for a bibliography and exhaustive commentaries on RUMPHIUS'S life and work.

*References:* (1) cf. Rumphius Gedenkboek (1902). (2) Verh. Kon. Akad. Wet. 13 (1871) 1-63. (3) HENSCHEL, Clavis Rumphiana... accedunt vita G. E. Rumphii etc. (1833) 139-202. (4) Rumph. Gedenkboek (1902) 1-12. (5) Album der Natuur (1885) 1. (6) SIRKS, Indisch Natuuronderzoek



J. BURMAN

(1915) 25-61. (7) BALLINTJN, Rumphius (1944). (8) GREENE, Landmarks of Botany I, Smiths. Misc. Coll. 54<sup>1</sup> (1909) 223. (9) MERRILL, Interpr. Rumph. Herb. Amb. (1917) 14. (10) MARTELLI, Le collezioni di G. E. Rumpf etc. (1903). (11) Amoen. Acad. 4 (1759). (12) Abh. Naturf. Ges. Halle 9 (1866) 145-389. (13) Philip. J. Sci. Bot. 11 (1916) 243-319.

## 22. Bontius; phytography in Java

Turning now our attention to Java, we find JACOBUS BONTIUS writing during his stay at Batavia (1627-1631) the earliest botanical work of importance there. A son to GERAERT DE BONT (or DE BONDT, Professor of Medicine and Botany and Director of the Leyden Botanic Gardens since 1587), he was born in 1592, arriving at Batavia in the retinue of Governor-General J. P. COEN, as his personal surgeon. Dutch power in the East Indies was young and in BONTIUS's term of office Batavia was twice besieged (1628, 1629). He suffered repeatedly from tropical diseases; it was rarely possible to leave the precincts of the town with some degree of safety, and he was a very busy physician and lawyer (he had brought his library of 2000 volumes with him, the largest consignment of books that had ever entered the Indies). Though his botanical writings cannot stand comparison to RHEEDE's and RUMPHIUS's works, when the period and circumstances are brought into account, his studies (main-

ly pharmacological) are to be highly appreciated. Here I limit myself to his phytographical results; particulars regarding his life and work may be found e.g. in SIRKS's *Indisch Natuuronderzoek* (1915).

He exchanged his botanical news and findings with those of A. VAN DUEREN, fellow-surgeon at Batavia. He was a good linguist, a sharp-eyed doctor, a reasonably good describer, but a poor draughtsman. His drawings are often difficult to understand, sometimes manifestly wrong. A helping hand (ADRIAAN MINTEN) failed to produce better results. The picture of *Ceiba pentandra* as a tree in Java is, however, the earliest in print and his 'Fructus sacer mangam' a good drawing, accompanied by some notes, of *Neesia altissima* Bl., a species that remained unnoticed for two centuries after.

BONTIUS evidently was no keen systematist nor an outstanding phytographer, but his was an inquisitive mind if not very critical. His notes, pharmacological facts and general remarks on about 70 species of easily identifiable plants are a chief source of information of the botany of the Batavia district at the time. Like RUMPHIUS he compared tropical species to those he had known at home and often guessed relationship with commendable accuracy. He was the first to point out the preponderance of trees and shrubs in tropical *Leguminosae* in contrast with the usually herbaceous European species.

It is to be regretted that BONTIUS's manuscripts came into incapable hands in Holland. His brother WILLEM waited 10 years before publishing the books (1642) and then only the first four, which have little to do with botany. A second edition (1646 or 1648) remained practically unnoticed, the third (1658) consisting now of six books appeared as a section in G. PISO's *De Indiae utriusque re naturali et medica* and has the *Historia Plantarum*; this at last received the recognition it deserved. The time-honoured custom of unauthorized changing and trimming before publication of manuscripts written by others, sometimes with undesirable results, seems here to have been replaced by indifference, which caused the loss of several of BONTIUS's notes; in *Historia Plantarum* 5 chapters appear to be left out by some oversight.

If BONTIUS, at least, had the makings of a good botanist, his successor in Javan plant description was a man of lesser gifts as a scientist.

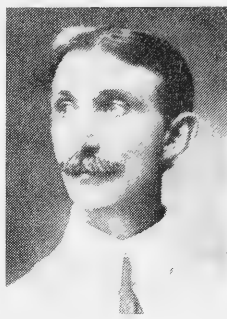
J. NIEUHOFF, a restless traveller in many parts of East Asia, was an intelligent though superficial observer. At Buru and Amboina (1659) he wrote (1) some general notes on the flora, and so he did at Malabar (1662); more important are his remarks on the Batavian flora. Visiting there for the second time in 1667, he was forced to stay till 1670. He said (ed. CHURCHILL): "During those three years I had sufficient opportunity to take a full view of the city, both within and without, in which I was so curious, as not only to make draughts of all its public structures, but also of such plants and trees as grow in and about that city; tho to confess the truth, the same could oftentimes not be undertaken without great hazards, as well from the wild



DIELS



DOCTERS V. LEEUWEN



ELMER



ENGLER

beasts, as from the barbarous Javanese, so that I durst not venture far out of the town without a good guard." He got acquainted with more than 125 kinds of plants, wild or cultivated, the majority clearly identifiable. NIEUHOFF's records contain many now forgotten medical applications, and several species appear in print for the first time. His padding out of his writings by means of the observations of BONTIUS and others without plainly indicating his sources, a breach of scientific custom which was in that period considered to be a smaller offence than at present, was commented on none too kindly by his contemporaries. He described and recorded for the first time in Java a number of species, mainly herbs or cultivated shrubs as he avoided the forest.

Of *Ricinus communis* L. he knows two varieties, a green and a purple one, and comes to an amazing conclusion: "On the top sprouts out a bunch of green buds, which opening by degrees, produce yellowish flowers; after which comes the fruit, not unlike a chestnut, containing a bean or kernel, which is very good food." This peculiar slip may be less due, perhaps, to lack of information than to a very recent introduction of the powerful seeds.

The activities of ANDREAS CLEYER, soldier of fortune, an enlightened if unreliable character, some time in the military service of the Company, some time Rector of the Batavian Latin School, and also holding high offices, decidedly furthered Malaysian plant description. Apart from his exchange of plants and letters with RUMPHIUS, he sent him PHILIPS VAN EYCK (1688), who proved to be of great service. In the last decades of his life, CLEYER occupied himself mainly with his hobby although he wrote only on Japanese plants; he died 1697 or 1698 at Batavia. On behalf of his botanical gardens and his studies, he introduced many species from Japan, assisted, when staying there, by his compatriot GEORG MEISTER, a Thuringian who had decided to try his profession (that of gardener) overseas.

On arrival at Batavia (1677), MEISTER was added to the garrison of the Castle. Soon after, he made a trip into the interior with an auxiliary expedition to a native prince. Without sighting an enemy, MEISTER returned after two months. In his narrative he does not appear to have noticed the flora

at all. He superintended in Java CLEYER's three botanical gardens (§ 36). In 1687, MEISTER sailed for Holland and in 1692, published a book on tropical gardening. Most unfortunately, MEISTER in his wish to compete with fashionable travel stories, filled his book largely with Japanese ethnology and all manner of irrelevant, sham erudite, data. In the history of Malaysian botany his book deserves a modest place; as regards phytography it is disappointing. There are again several first records for Java but, possibly, most important was his transfer to Europe of some 400 kinds of seeds, mostly Malaysian, more than 300 coloured plates of Malaysian and Japanese plants and a considerable living collection. He also must have assisted CLEYER in the forwarding of herbarium specimens to several botanists in Europe. (e.g. to COMMELIN, *Pterocarpus indicus* WILLD. and *Cassia javanica* L.).

References: (1) NIEUHOFF, *Zee en Lant Reize* (1682), ed. CHURCHILL, *Voyages & Travels* 2 (1732).

### 23. *De Jager, Ten Rhijne, and Witsen*

Pre-Linnean Malaysian phytography received notable aid from HERBERT DE JAGER, roaming doctor and linguist, who sailed for the Indies in 1663. He was repeatedly obliged to travel to Persia but journeyed also far and wide in other directions. He met RHEEDE and his assistants on the Malabar Coast (c. 1680), studied plants on the coast of Timor some time before 1683, in that year stayed at Batavia, and went in 1684 to Malacca, always on the move in spite of bad health, always exchanging plants and letters on scientific problems with the best minds of the age, in particular RUMPHIUS. To the latter he sent e.g. descriptions of the Lontar Palm, Camphora, Santal Wood, and Benzoë; from Malacca he forwarded several plants. N. WITSEN, scientist-burgomaster of Amsterdam, one of his pen friends, testified at his death (1694, at Batavia): (transl.) "his erudition caused his death in poverty at Batavia; he left a treasure of learned annotations, but all were neglected, hardly anybody among us being interested". DE JAGER's severe opinion on the work of other scientists (he knew Father MATTHEUS (cf. § 20) and judged him to be "not even in the slightest degree a botanist"), his often somewhat self-asserting style of writing, his erratic per-

sonality, and his untiring linguistic research in connexion with botany, find a curious parallel in H. HALLIER (see § 70). Contrary to the latter, however, he was not a very keen-sighted taxonomist and he is partly responsible for the long sustained misconception of LINNAEUS and others that a generally identical vegetation flourished in all parts of the tropics as he reported to have noticed no significant change in the flora on his journey from Batavia to Ispahan (1).

N. WITSEN, who held a place in the scientific world somewhat similar to that of Sir JOSEPH BANKS a century later, had a considerable interest in East Indian plants. In 1700 he received a consignment of Javan plants and ordered them to be pictured in colours. A volume of 232 sheets is still kept at TEYLER'S Museum at Haarlem; the drawings were indexed and named by J. BURMAN in 1748, and again by M. VAN MARUM and BLUME.

I have had occasion to mention W. TEN RUIJNE (§ 20), a surgeon of great fame, who in those years led a life much resembling that of DE JAGER'S. He had a collection of Timor plants and also took part in the scientific intercourse in letters, his correspondents in particular being English botanists; he helped RHEEDE and sent living plants to Europe. Among the collectors of the day SYLVANUS LANDON (also 'LANDMAN') ought to be remembered. The earliest record of a Bornean herbarium specimen (before 1702) has his name attached to it; in the SLOANE herbarium VAN STEENIS observed some specimens from Flores, collected by him in 1679.

References: (1) DE JAGER, Letters in VALENTINIUS, Natur- und Materialien Kammer 3 (1704).

#### 24. Philippine pre-Linnean phytagraphy; Father Kamel

An outline of pre-Linnean botany in the Philippines (1) has been drawn by E. D. MERRILL (1926). As a matter of record may be noted his statement that CLUSIUS'S *Rariorum Plantarum historia* (1601) contains a first reference to a Philippine plant *i.e.* *Illicium sp.* In 1582, CLUSIUS already published on DRAKE'S specimen of *Gnetum gnemon* L. collected in 'Beretina' in the Philippines (§ 9), and I am not at all certain that Philippine botany begins not even earlier. MERRILL'S conclusion on the botanical writings of the period is: "The most that can be claimed for them is a slight historic value, chiefly in reference to the approximate time of introduction of various economic plants." This is undoubtedly correct, if seen from the point of view of modern systematic botany; pre-Linnean botanical science in the Philippines maintained very slender contacts with Europe and, consequently, was only very incidentally considered by phytagraphers. An exception must be made for GREGORIUS JOSEPHUS CAMELLUS (G. J. KAMEL S. J.).

Father KAMEL, a Jesuit missionary, was born in 1661 at Brünn (Bohemia) and, after having followed his calling in the Marianes, went to the Philippines. His general interest in taxonomic botany surpassed his pharmacological occupation (he had a little shop at Manila where he supplied the na-

tives with medicinal herbs) and made him send considerable treatises and many drawings of Philippine plants to RAY and PETIVER (§ 14).

A first note on the 'true Amomum' appeared in 1699 followed in the same year by a paper (2) on the 'Nux vomica legitima serapionis' and an exciting anecdote concerning the 'St Ignatius beans'. An important phytagraphical contribution was his *Descriptiones Fruticum et Arborum Luzonis*, published as a separate section in RAY'S *Historia* (vol. III, or 'Supplement'), which also contains his study *Herbarum aliarumque stirpium in Insulâ Luzone Philippinarum primaria nascentium*. The illustrative drawings accompanying these papers were probably later published by PETIVER (3). Four sets of descriptions of climbing plants, *Tractatus de plantis philippensis scandentibus*, appearing in the 'Philosophical Transactions' (1704-1706), concluded his work, that has been too little studied, no doubt, because his influence on botanical nomenclature has been slight.

KAMEL made the first deliberate attempt towards a Philippine flora, and the identification of the majority of his species would not seem difficult as the descriptions are reasonably detailed and accurate though, sometimes, rumours were too readily accepted for fact. Pater CAMELLUS died in 1706 at Manila.

As regards a number of unpublished manuscripts by other priest-authors and some minor data, *e.g.* Father J. E. NIEREMBERG'S botanical notes (4), I may refer to MERRILL'S essay.

References: (1) MERRILL, Enum. Philip. Fl. Pl. 4 (1926) 43-56. (2) CAMELLUS, in Philos. Transact. 21 (1699) 2-4, 88-94. (3) PETIVER, Gazophylacii naturae (1702). (4) NIEREMBERG, Historia Naturae (1635).

#### 25. Pre-Linnean period in the Malay Peninsula

The Malay Peninsula, apart from scattered references in literature and occasional scraps of observations by travellers, seems to have produced in pre-Linnean times no phytagraphic literature of historical importance. Only one small paper dealing solely with peninsular plants appeared, by Father CLAUDE DE BÈZE S. J. (also spelt DE BAIZE). It contained descriptions of 9 kinds of fruit (1). This is good thorough work, and it is to be regretted that no more of his observations were laid down, the more so as he—about 1690!—gave a first indication of the limits of the Malaysian flora towards that of India. He stressed the point that some plants occurred both in the Malay Peninsula and in India others, however, grew in the Malay Peninsula but were absent from India.

After a life of hardship and adversities (he was even kept prisoner by the Dutch but treated with the civility usually extended in the 17th and 18th centuries towards captives of scientific or spiritual distinction, and so enabled to continue his studies in natural sciences), he died in 1695 in Bengal.

References: (1) DE BÈZE, Descr. de quelques arbres *etc.* in Mém. Acad. Roy. Sci. Paris 4 [1666-1699] (1731) 327-333.

## FROM 'SPECIES PLANTARUM' TILL THE ESTABLISHMENT OF THE BUITENZORG GARDENS

<p>26. <i>Species Plantarum</i> and Malaysian phytophraphy . . . . . xciii</p> <p>27. Swedish exploration; Retz and Thunberg . . . . . xciii</p> <p>28. Banks and his contemporaries . . . . . xciv</p> <p>29. English periodicals before the 19th century . . . . . xcv</p> <p>30. French phytophraphy; Lamarck and his collaborators . . . . . xcv</p> <p>31. French exploration; Poivre, Commer-son, Sonnerat . . . . . xcvi</p> <p>32. French expeditions; Deschamps, Lesschenault . . . . . xcvi</p> <p>33. French horticulture; E. P. Ventenat . . . . . xcvi</p> <p>34. Phytophraphy in Holland; Burman, Houttuyn . . . . . xcvi</p>	<p>35. Incidental contributions; Gaertner, Willdenow . . . . . xcvi</p> <p>36. First establishment of botanical gardens in the East Indies . . . . . xcvi</p> <p>37. The 'Asiatic Society' and the 'Bataviaasch Genootschap' . . . . . xcvi</p> <p>38. Phytophraphy in Java; Radermacher and Von Wurm . . . . . xcix</p> <p>39. Incidental contributors in Malaysia; de Noronha . . . . . xcix</p> <p>40. Raffles and Horsfield . . . . . c</p> <p>41. Father de Loureiro's 'Flora Cochinchinensis' . . . . . ci</p> <p>42. Indian research; the 'United Brotherhood', Roxburgh . . . . . ci</p> <p>43. Penang Gardens . . . . . ci</p> <p>44. Philippine phytophraphy . . . . . ci</p>
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### 26. *Species Plantarum* and Malaysian phytophraphy

In 1753 a new era in botany, and especially in phytophraphy, was marked by the appearance of *Species Plantarum*. It was the first work in which an effort was made to give a comprehensive summation of all known species by means of succinct, systematically built, specific analyses; its briefness, its artificial but lucid and practicable taxonomic arrangement based—in general—on the sexual characters, and its name-giving, according to a consistently applied binomial method, earned it a foremost place, then and now, in systematic botany. Descriptive botany acquired new directives but the influence of *Species Plantarum* on Malaysian phytophraphy was neither immediate nor entirely favourable. Communications were long and scarce which made, in conjunction with the small number of academically trained botanists in Malaysia, for a delayed understanding of its importance; on the other hand, LINNAEUS seems to have been acquainted least with our region among all other parts of the world. Moreover, this 'complete' catalogue brought about a strong tendency to reduce all available specimens—whether old or newly discovered—to species included in *Species Plantarum* which prejudiced the studies and conceptions of describing botanists in the second half of the 18th century. This resulted in an unwarranted widening of original Linnean species-limits, and often in misinterpretation and confusion. A second wrong conviction thwarting rapid development was the belief, also advocated by LINNAEUS, that the tropics had a homogeneous vegetation round the globe. Dozens of species were based on material partly from tropical America or Africa and partly Asia, which could be right only in case of some pantropical weeds or fruits. Travellers in the tropics rarely succeeded in penetrating into the interior and the most striking features of the vegetation along the shores were pantropical species, already introduced and acclimatized during a considerable period. Though specimens from Malaysia

were awaited in Europe with eager interest, new species were, very often, not so much anticipated or desired as information concerning time-honoured but imperfectly known medicines.

So, if LINNAEUS's work was most conducive to clearer phytophraphy and constructive taxonomical research, yet this new light was focussed on Europe, (South) Africa and the Americas, leaving tropical Asia much in the same shadows as before.

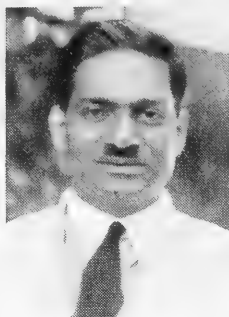
### 27. Swedish exploration; Retz and Thunberg

Following the example of his illustrious predecessors, the energetic Swede, who occupied the Chair of Botany at Uppsala since 1742, persuaded sea-captains to bring him plants from remote regions and also instilled an enthusiasm into his pupils to roam in the wildest parts of the world in quest of remarkable specimens. M. LAGERSTRÖM, a Director of the Swedish East India Company, gave orders to this purpose analogous to those of the East India Companies of other nations (*cf.* § 8).

One of the pupils of LINNAEUS in the service of the Swedish Company was P. OSBECK (1723–1805), who sailed to China as a chaplain and stayed July 15–17, 1751, off the coast of West Java (near Anjer) where he collected, to return in 1752, when they cast anchor in Meeuwen Bay; again plants were secured. OSBECK's diary (*Dagbok*) appeared in 1757 and was subjected to a study by MERRILL (1916), who demonstrated that among many interesting observations on the ecology and biology of plants and animals, 26 species and 2 genera were new and legitimately described (1). The Linnean herbarium contains about 600 of OSBECK's specimens; he was the collector of the type specimen of Java's most popular orchid, *Phalaenopsis amabilis* (L.) BL. His materials arrived in time to be included in *Species Plantarum* but were largely neglected as happened to RUMPHIUS's records. C. G. EKEBERG and A. SPARRMAN collected also (1766) in West Java, much in the same localities as OSBECK, adding to their collections specimens from an islet



FOXWORTHY



FURTADO



GAMBLE



MISS GIBBS

near SW. Sumatra in 1767. Their plants were again studied by LINNAEUS. Passing by, for the moment, one of his other pupils who played a role in Malaysian phytography (D. C. SOLANDER, § 28) I may conclude participation in the advancement of Malaysian botany of the period in Sweden by referring to A. J. RETZ and C. P. THUNBERG.

A. J. RETZ(IUS), born in 1742, botanical demonstrator and professor in Lund University, wrote many phytographical publications which are now practically forgotten. An exception is his *Observationes botanicae* which appeared in six fascicles between 1779 and 1791, supplemented by J. G. KOENIG's studies (cf. § 42). A number of Malaysian plants were described on data supplied by P. I. BLADH and by 'Magister' WENNERBERG (Java and Sumatra). The small portion of RETZ's works now procurable without an intensive search suggests that his contributions should have received more recognition.

In 1770, C. P. THUNBERG (1743–1828), student of LINNAEUS's and his devoted friend, went to Amsterdam where he studied J. BURMAN's rich collections. Travelling at leisure and studying in the best places, he proceeded to Leyden, The Hague, and France, returning to Amsterdam in the following year. Together with several other plants lovers, BURMAN and M. HOUTTUYN introduced him into the benevolent attention of the wealthy Directors of the East India Company, and he embarked in their service for Batavia and Japan. His chief and lasting merits as a systematist and phytographer were gained in South Africa and Japan; our interest is limited to his contribution to Malaysian botany. He collected plants—which served as a base to his own later writings and those of others—in Java in the first half of 1777; on the voyage home he stayed 7 months in Ceylon (till February 1778), and then returned to Europe. He succeeded LINNAEUS's son in 1784 as a Professor of Botany in Uppsala University. Of his works *Nova Genera Plantarum* (1781–1801) and a *Florula cellanica* (1825) are to be mentioned here. Under his direction were prepared, after the example set by LINNAEUS, a number of academical papers. Especially dealing with Malaysian botany are a paper on *Ficus* (1786), the *Arbor toxicaria macassarensis* (1788), *Myristica* (1788), *Caryophyllis aromaticis*

(1788), *Benzoë* (1793), *Oleo Cajuputi* (1797), *Styrax* (1813), and a *Florula javanica* by WINBERG and WIDMARK (1825). The latter book is a modest attempt by two of his pupils and consists of two small treatises. The first, by WINBERG, contains a list of 325 species brought by THUNBERG from Java completed by 16 described species; the second, by WIDMARK, has some new species among 27 descriptions and a further list of 402 names of THUNBERG's specimens. The booklet has had recently the attention it deserved (2). O. SWARTZ described several of THUNBERG's Malaysian ferns and orchids.

References: (1) Am. Journ. Bot. 3 (1916) 571–588. (2) Blumea 6<sup>2</sup> (1949).

#### 28. Banks and his contemporaries

In England, the interest in and study of exotic plants (and also those of Malaysia) continued in this period in much the same manner as before (see § 14–16). The Gardens and collections at Kew, in the course of the years, advanced to the first place they have held ever since; Sir JOSEPH BANKS (1743–1820), among plant amateurs, set an example for all time by his munificence, his untiring efforts in promoting botany, and his fair and gentlemanly conduct towards fellow botanists irrespective of whether they belonged to enemy nations or not, his only criterion being if botany might prosper and serve all mankind (1). BANKS's excellent library and collections commanded admiration and eventually formed the nucleus of all collections pertaining to natural history in the British museum; among his numerous dried specimens from Malaysia were plants collected by himself and his librarian D. C. SOLANDER during their visit to the Archipelago with the 'Endeavour', the ship which carried J. COOK on his first navigation round the world. In the second half of 1770 they called at SW. New Guinea, and Savu Island, and in 1771 remained some time at Batavia and Anjer; they also explored some islets off the Java coast. In the same year they returned to England. Draughtsmen and painters had accompanied them, for instance S. PARKINSON, whose 'Journal' was edited in 1773 (2), and whose drawings are preserved in the British Museum as is a manuscript of SOLANDER's *Plantae Javanenses*. In 1773, SOLANDER resumed work in the British



Museum (he died in 1782) and J. DRYANDER, also a Swede, was employed by BANKS in his place.

DRYANDER's chief work is a masterly catalogue of the Library of BANKS (5 volumes, 1796–1800); Malaysian phytophagy was furthered by him directly in two small papers on Sumatran trees (3). In addition, he supervised with SOLANDER the first (1783) and, partly, the second edition (1810–1813) of *Hortus Kewensis*, by W. AITON (father) and W. T. AITON (son), in which many Malaysian plants were described; he also worked on ROXBURGH's *Plants of the Coast of Coromandel*. He died, a famed botanist, in 1810. To BANKS's third secretary and librarian, R. BROWN, I will return later (§ 49).

BANKS had assembled many of EHRET's drawings (§§ 16, 17) but on the latter's death (1770) England had no artist of equal skill and training. About 1790, however, the Austrian brothers FERDINAND and FRANCIS BAUER (FRANCIS having been persuaded by BANKS to remain in England since 1788), made exemplary plant drawings. FRANCIS in particular pictured many Malaysian species (orchids were his speciality) and published from 1791–1793 to 1800–1801 *Delineations of Exotic Plants*.

A somewhat isolated place was occupied by J. HILL, who was denied recognition as a scientist of standing during his life and afterwards. His publication of a part of *Hortus Malabaricus* has been mentioned (§ 20); in 1759 he wrote on the plants at Kew (*Exotic Plants*) and composed a *Vegetable System* in 26 volumes (1759–1775), which remains to be studied in its aspects to Malaysian botany.

CH. KONIG worked in the herbarium of BANKS and wrote some good papers of importance to Malaysian phytophagy, most of them appearing in 'Annals of Botany' (cf. § 29). I refer here to *Observations on the Durion* (4), *On Aegiceras fragrans* (5), *Some Account of the Sago Palm* (6), and *A few botanical observations* (7).

Other authors to be noted are CH. MILLER, first Curator of the Cambridge Botanic Gardens, who collected in Sumatra (Bencoolen and Musi Basin) giving an account in 1778 (8), and TH. PENNANT, who in volume 4 of his *Outlines of the Globe* presented a rather uncritical, here and there annotated, enumeration of mainly Malaysian and Indian plants after the Linnean method, with a synonymy of Rumphian and Rheedian names (1800). His is the word that remains true till the present day: 'Sumatra still wants its florist.' MERRILL studied the nomenclature connected with PENNANT's work (9).

English travellers, visiting Malaysia after COOK, also added to the description of its vegetation. There is a stirring narrative by TH. FORREST, who explored the Moluccas and New Guinea between 1774–1776 in search of seedling nutmegs on behalf of the English East India Company (10). From the Moluccas CHRISTOPHER SMITH sent ample materials for future Malaysian phytophagy to England (1798) and to ROXBURGH in Calcutta. Much English enterprise I must leave unmentioned.

*References:* (1) ARBER, Sir J. Banks and Botany in Chron. Bot. 9 (1945) 94–106. (2) PARKINSON,

Journal of . . . the 'Endeavour' (1773). (3) DRYANDER, Bot. Descr. Benjamin Tree of Sumatra in Philos. Trans. 77<sup>2</sup> (1787) 307–309; Bot. Besch. Benzoë Baum Sumatra in Mag. Bot. Zürich 1<sup>2</sup> (1787) 69–71. (4) Transact. Linn. Soc. London 7 (1804). (5) Ann. Bot. 1 (1805) 129–133. (6) *ibid.* 193–200. (7) *ibid.* 356–358. (8) MILLER, Account of Sumatra in Philos. Trans. 68 (1778) 161–179. (9) Journ. Arn. Arb. 29 (1948) 186–192. (10) FORREST, A voyage from Calcutta to the Mergui Arch. (1792).

### 29. English periodicals before the 19th century

This period also includes the starting point of several scientific journals, in England and in Europe generally as well as in tropical Asia, entirely or partly devoted to phytophagy. The earliest periodical papers contained among the most diversified subjects now and then descriptive contributions to Malaysian botany. The most important had been the 'Philosophical Transactions' (since 1665), and the Austro-German 'Ephemerides' (1670 onwards, under various titles).

A new serial mainly devoted to picturing plants, was the 'Botanical Magazine or Flower Garden displayed' (1787), begun by W. CURTIS, Director at 'Chelsea Physick Garden', later continued by J. SIMS, W. J. and J. D. HOOKER and others, as a truly magnificent series of plates and descriptions of undisputed scientific merit in which many dozens of Malaysian species have been treated. A history of this periodical, including a survey of 19th century English horticultural publications, was published by W. BOTTING HEMSLEY in 1906, further supplemented by the portraits and biographies of the persons to whom separate volumes were dedicated (1931). In this connexion Sir J. E. SMITH's 'Exotic Botany' is to be remembered, which was even better in appearance than CURTIS's Magazine but persisted only 2 years (1804–1805).

Of similar design was H. C. ANDREWS's 'Botanists' Repository' of which 10 volumes appeared between 1799 and 1811. Dealing partly or wholly with Malaysian plants, dozens of articles in which illustrations, if any, were of lesser importance, appeared in the botanical section of the 'Transactions of the Linnean Society of London' (since 1792). Some interesting papers are found in CH. KONIG and J. SIMS's 'Annals of Botany' (1805–1806, 2 volumes, e.g. on *Canarium* by CH. KONIG and on *Ficus* by C. L. WILDENOW).

### 30. French phytophagy; Lamarck and his collaborators

In France the Linnean system met with opposition. There was, in 1763, the little appreciated *Familles des Plantes* by M. ADANSON, a versatile scholar who wrote, as a preface to his work a particularly important history of botany. He tried for a natural system but applied highly artificial methods; his contacts with Malaysian botany need further study. Classification according to the natural system advocated by A. L. DE JUSSIEU and his nephew B. DE JUSSIEU won a wider approval.



Of more direct importance to our region was J. B. A. P. DE LAMARCK's *L'Encyclopédie méthodique, botanique* (1783–1808). LAMARCK, to whom we owe the dichotomous key—so efficient a tool to every student of modern systematic botany—treated in this large work (and in several of his other publications) a great many plants from tropical Asia, collected by COMMERSON, SONNERAT, and others. The first four volumes were of his own pen, the fifth was composed in collaboration with J. L. M. POIRET, who wrote the concluding three volumes, supplementing these by another five volumes (*Supplément*, 1810–1817). This new attempt for an enumeration and description of all known species meant a decided advance in phytophraphy. The Linnean method of noting briefly and summarily some selected striking characters, which had contrasted against the usual pre-Linnean rambling and unordered, rather needlessly extensive, manner of description, was now avoided as well as the recently re-adopted habit of listing every conceivable property of the plant under consideration without differentiating between points of major and minor interest. It consciously tried to outline clearly the species-limits as a whole in a concise manner. The Linnean manner aimed at differentiation at shortest notice; the French school intended to compose descriptions which, by themselves, provided an adequate word-picture of the plant but had to be short in order to be easily handled in differentiating allied species. This principle was often successful though sometimes the enormous, rapidly expanding, task had to be accomplished with some neglect of desirable detail. Complementary volumes of plates, reasonably well executed, completed the cyclopedias (1).

*References:* (1) LAMARCK & POIRET, *Tableau encycl.* 3 vols, and *Recueil des Planches* 4 vols (1791–1823); for dates of publ. (*Encycl. méth.*) see WOODWARD, *Journ. Bot.* 44 (1906) 318.

### 31. *French exploration; Poivre, Commerson, Sonnerat*

In the exploration of eastern Asia, France had its share from the beginning. The second half of the 17th century saw the adventurous life of P. POIVRE, missionary and plant collector in China and Indo-China. Losing one arm in a sea-battle, he changed his profession and, in the service of the French East India Company, repeatedly sailed to Cochinchina, the Moluccas, the Philippines, and Madagascar. A trip to Timor and Celebes to smuggle nutmegs (1755) was succeeded by his appointment as Intendant of Réunion and Mauritius. He founded the Botanic Garden at Pamplemousses and Le Réduit, and returned to France in 1773; he died in 1786. Several essays and articles from his hand were published but more remained in manuscript; H. CORDIER gave some extracts. His plants were part of the Malaysian materials described by LAMARCK and POIRET. To these were added the huge collections of PH. COMMERSON.

COMMERSON, a naturalist of some repute and medical doctor, joined the expedition of L. A. DE

BOUGAINVILLE, first of a series of voyages under the French flag to the remotest corners of the globe, made for various reasons but always commissioned to promote natural sciences in every respect. In 1768 'La Boudeuse' and 'l'Étoile' entered the East Indian Archipelago, touched at Buru Island (Moluccas), and spent some time at Batavia. The ship returned to France but COMMERSON left the expedition to assist POIVRE at Mauritius. COMMERSON, after further exploration, died there in 1773. Many Malaysian plants were preserved in his Herbarium, at the time one of the finest in existence, counting more than 25000 sheets, which were most welcome to LAMARCK and POIRET (§ 30). The plants and manuscripts were brought to France after his death by JEANNE DARRÉ, his wife and fellow collector, the first woman to travel round the world. Some labels have been mislaid and thus some ferns and other plants were described for Timor or Java which actually belong to Réunion.

P. SONNERAT worked with COMMERSON in Mauritius for more than three years and then sailed, in 1771, with POIVRE to the Moluccas hunting economic plants and spices. They went to the Philippines also and, cruising southwards, came close to New Guinea. After COMMERSON's death, SONNERAT returned to France. Most of his plants were kept at Paris and some served to augment the material basis of LAMARCK's later volumes. His *Voyage à la Nouvelle Guinée* (1776) is phytophraphically unimportant.

### 32. *French expeditions; Deschamps, Leschenault*

The next French expedition to enter Malaysia would have contributed greatly to its phytophraphy if fate had willed it.

L. A. DESCHAMPS, a young surgeon and naturalist, had been asked to join the search for the lost French explorer J. F. G. DE LA PÉROUSE, under A. R. J. BRUNY D'ENTRECASTEAUX. 'La Recherche' and 'l'Espérance' sailed in 1791, bound for the Pacific. Charged with the study of natural history were, beside DESCHAMPS, J. J. HOUTOU DE LA BILLARDIÈRE, surgeon and botanist, the Roman Catholic priest and naturalist L. VENTENAT, the gardener LAHAIE, and the artist PIRON. In 1792 the ships called at Ambon, the next year cruised in the east of the Archipelago and, after dropping anchor at Surabaya and learning the course of the French Revolution, the company were divided by internal political strife which ended by the ships and men being taken into custody by the Dutch. VENTENAT, on account of illness, was released and returned to Mauritius where he died (1794). DE LA BILLARDIÈRE was finally detained at Batavia, though receiving the freedom of the town and its surroundings. He collected plants and returned to France in 1795. His specimens (and all the herbarium made so far by the members of the expedition) were ceded to the English by D'AURIBEAU, at that time leader of the expedition, but Sir J. BANKS subsequently returned the majority to the care of DE JUSSEU. Some observations made in Malaysia are found in *Novae Hollandiae Plantarum specimen* (1804–1806) and *Ser-*



HALLIER



HARMS



HASSKARL



HEMSLEY

*tum Austro-Caledonicum* (1825) by DE LA BILLARDIÈRE.

MRS VAN STEENIS has extracted for incorporation in vol. I of this Flora the itinerary of DESCHAMPS; contained in his diary. C. A. BACKER and C. G. G. J. VAN STEENIS have identified the plants depicted by him (1). I owe many of the following data to their communication.

The Javan vegetation was enthusiastically studied by DESCHAMPS. He accepted the offer from the Dutch to explore Java and so was, after some lapse of time, acknowledged by N. ENGELHARDT, Governor of NE. Java, as being commissioned to 'study all trees, plants, fishes, birds, and other animals through the whole of the highlands'. In four years (1794-1798) he travelled far and wide through the Javan wilds; many volcanoes were climbed by a European for the first time in history and he assembled in unexplored regions many species now exceedingly rare in the island. He intended to write a 'Flora Javana'. I must refer to VAN STEENIS and BACKER's (unpublished) study for an account of his finds (which included the first record of *Rafflesia*). On returning to France (having resided at Batavia from 1798 to 1802 as a honoured citizen), he was in sight of his native land when his ship was intercepted by the British, and he lost all his papers and specimens. The plants are now untraceable but the manuscripts remain, most of these illustrated by exceedingly well executed drawings. An anthology from his papers seems a duty to this intrepid and untiring explorer and to the tradition of phytophagy.

The next French expedition (1800-1804) led by N. BAUDIN, consisted of the 'Géographe', the 'Naturaliste', and the 'Casuarina', this latter vessel being under the command of DE FREYCINET. They were more favourably fated than their predecessors but brought only incidentally collected plants to Europe and might pass unnoticed had not J. B. L. C. TH. LESCHENAULT DE LA TOUR been brought to Java. LESCHENAULT, a world-wide traveller, afterwards Director of the Botanic Garden at Pondicherry, made important collections in Java, Madura, and Timor but, excepting his paper on *Antiaris* (2), published little of phytophagical interest regarding Malaysia. His plants, preserved at Paris, gradually were studied and adopted as type mate-

rial of a number of Malaysian species and as the base of DECAISNE's Timor Flora (1835, § 105).

References: (1) MS., not yet published. (2) Ann. Mus. Hist. Nat. Paris 16 (1810) 478.

### 33. French horticulture; E. P. Ventenat

In France, from horticultural sources, little was added to Malaysian phytophagy in this period. E. P. VENTENAT, elder brother of the naturalist accompanying D'ENTRECASTEAUX, superintended the Malmaison Gardens, which made him publish a series of plates under the title *Jardin de la Malmaison* (1803-1805), a *Choix des Plantes* (1803) completed by a *Notice* (1807), and a *Decas Generum* (1808); these are able well-considered articles in which some Malaysian plants are described. Among the French periodicals I only refer to 'Annales du Musée d'Histoire Naturelle de Paris', appearing since 1802.

### 34. Phytophagy in Holland; Burman, Houttuyn

Holland, though the natural centre for the development of Malaysian phytophagy, contributed but rarely in print. Support was given to foreign artists, collections increased at no small care or expense, but few original studies reached the printer's.

N. L. BURMAN, having been schooled as a botanist by his father, after his visit to LINNAEUS (1760) who supplied him with some notes for his planned book, published a *Flora Indica* in 1768, consisting of 241 pages of text and 67 plates. MERRILL devoted one of his studies (1) to it and reported that 115 Javan and 90 Cingalese were among its c. 1305 species. The work is scarcely more than a compilation, though even this merit is dimmed by a lack of accuracy. MERRILL has pointed out that in most cases the species have been assigned to their native region, but he indicated some peculiar errors. MERRILL studied *Flora Indica* from a bibliographic point of view and interpreted the species contained in it guided only by the text. The descriptions in the book, however, are too summarily drafted to allow this method and examination of the typifying material is indispensable. A close interpretation is, moreover, vital in many cases

where priority of name is considered; BURMAN's *Flora* appeared rather soon after *Species Plantarum* and well before the flora of Malaysia had received the attention of various 19th century phyto-geographers. It is, therefore, most fortunate that BURMAN's plants have been preserved at Geneva (DELESSERT Herbarium) though scattered through the general Herbarium. Given the time and patience, the majority, if not all, may be and should be traced one day, and a critical interpretation so become possible.

HOULTUYN's numerous works—mostly phyto-graphical—formed also the subject of MERRILL's taxonomo-bibliographic investigations. M. HOULTUYN was a medical doctor at Hoorn, since 1781 a member of the Batavian Society (cf. § 37). MERRILL made an exhaustive list of HOULTUYN's publications (2). HOULTUYN's main botanical work is the 2nd series of his *Natuurlijke Historie*, a 14-volumed work in imitation of *Species Plantarum*, appearing from 1773–1783, entitled *Handleiding tot de plant-en kruidkunde*. HOULTUYN's works were almost forgotten—MERRILL thought this partly due to their rarity, but many are among the commonest of 18th century books—and they should be considered in matters of nomenclature. The *Handleiding tot de plant-en kruidkunde*, consisting of more than 8600 pages of text supplemented by 105 copper plates, was several times reissued, and also incorporated in G. F. CHRISTMANN and G. W. F. PANZER's *Vollständiges Pflanzensystem* (14 vols, 1777–1788). MERRILL estimated that the neglect of HOULTUYN's unscholarly written books caused 160 new binomials to be omitted from all reference works; 40 of these pertain to the Indo-Malayan region. HOULTUYN wrote also on Sumatran benzoë and camphor (3), on the 'nutmeg flower' (4), and an extensive illustrated work on indigenous and exotic timber (*Houtkunde*, 1773–1791, with SEPP).

References: (1) Philip. J. Sci. Bot. 19 (1921) 329–388. (2) Journ. Arn. Arb. 19 (1938) 291–375, also *ibid.* 20 (1939) 264–268. (3) Verh. Holl. Mij. Wet. 21 (1784) 257–287. (4) *ibid.* 26 (1789) 211–231.

### 35. *Incidental contributions; Gaertner, Willdenow*

Important additions to Malaysian phyto-geography appeared in other parts of Europe. J. GAERTNER, born at Calw in Württemberg, wrote his classic *De Fructibus et Seminibus Plantarum* (1788–1807). Visiting wherever fruits might be studied (BANKS and THUNBERG's Herbaria), he composed a carpology that was never equalled, the base for the modern interpretation of fruits and seeds. C. F. GAERTNER, his son, published corrections in 1825(1). A. J. CAVANILLES, between 1793 and 1801, published his *Icones et Descriptiones Plantarum*, largely of importance to the West Indies but not to be overlooked when studying the acclimatized elements in Malaysia and the Philippine collections of the 'Malaspina' (see § 44). C. L. WILLDENOW edited in 6 volumes the 4th edition of *Species Plantarum* (1797–1830) both in scope and as regards phyto-geography a decided improvement, particularly in respect of the Malaysian flora (cf. also §§ 29, 41, 42).

References: (1) *Flora* (1825) 476–480.

### 36. *First establishment of botanical gardens in the East Indies*

Phyto-geography, though essentially a branch of science thriving in a European climate, had emancipated itself in this period and great progress was made in tropical Asia often in close collaboration with Europe. In the following lines, tropical Asiatic and Malaysian phyto-geography are considered as one whole; only in the latter half of the 19th century Malaysia and its surrounding regions followed each more or less independent courses of development.

Botanical gardens—collections of living plants kept for scientific purposes—since GARCIA, RHEEDE, and RUMPHIUS, were destined to form in the East the natural centre for phyto-geography; whether many of the Gardens were maintained with an eye to the necessity of having a ready supply of medicinal herbs and fresh vegetables is irrelevant, the point is that they did offer an opportunity for scientific investigation, and were understood to do so.

At Buitenzorg, since 1744, the Honourable Company maintained a mansion and gardens which were to provide, in 1817, the grounds for the present Botanic Gardens. Another botanic garden, not yet mentioned in this history, (§ 22), was that of CHR. KLEINHOF, situated (c. 1750) somewhere near the centre of Batavia. It is known that it produced plants sent to BURMAN, but there is very little information and it has disappeared without trace. In Malacca was a botanical garden owned by C. DE VENDT (cf. § 42), and in the Philippines a Government sponsored garden at Manila (cf. § 39), both these gardens existing c. 1790, and this is about all (cf. §§ 38, 39) that has become known about them (1).

References: (1) BACKER, Verkl. Woordenb. (1936); RETZ, Obs. bot. 3 (1783) 62; Philip. J. Sci. Bot. 7 (1912) 363–369.

### 37. *The 'Asiatic Society' and the 'Bataviaasch Genootschap'*

The foundation of the Calcutta Botanic Gardens (1787, by R. KYD), followed by the issue of the 'Asiatick Researches' or 'Transactions' of the Asiatic Society of Bengal (in 1788) put phyto-geography in India on a new footing. The Asiatic Society's 'Straits Branch' at Singapore, published in later years many papers dealing with the phyto-geography of the Malay Peninsula in its 'Journal' (since 1878); the 'Journal' of the mother society contributed incidentally to Malaysian phyto-geography till the present (started 1832).

If, however, the English had set an example to the Dutch in active research and field work, the Dutch were first (1778) to establish a learned society in the East, the 'Bataviaasch Genootschap van Kunsten en Wetenschappen' (Batavian Society for Arts and Sciences) which, since 1779, published 'Verhandelingen'. The 'Bataviaasch Genootschap' transferred the promotion of natural sciences in 1850 to the 'Koninklijke Natuurkundige Vereeni-

ging' (Royal Society for the Natural Sciences; 'Royal' since 1860) and phytophraphy thus disappeared from the 'Verhandelingen' (cf. § 61).

### 38. *Phytophraphy in Java; Radermacher and Von Wurmb*

About the middle of the century, phytophraphy made small progress in the Dutch East Indies. There was merchant J. G. LOTEN, who brought DE BEVERE(N) with him to Java from Ceylon. DE BEVERE made (1754-1757) a set of 144 beautifully executed coloured plates for him (13 plates purely botanical), but they never appeared in print excepting a number used in zoological works of later date (1).

J. C. M. RADERMACHER, when he arrived in Java for the second time (1764) had made a good start both as a student of natural history and as a servant of the Company and now he rapidly climbed to a position enabling him to launch the 'Bataviaasch Genootschap'. This society purposed the advancement of ethnography, linguistics and natural sciences and, in addition to the efforts of many among the 192 members residing in all Asia between the tropics, they were aided by a Government order to all officials for collaboration. RADERMACHER presented a house to the Society, to store the growing library and collections, which included a small herbarium. An explicit instruction for preserving and forwarding dried plants completed the first volume of the 'Verhandelingen'. RADERMACHER wrote rather indifferently on a wide range of subjects. He accomplished what might be expected of a director: he drew the attention of desirable protectors, fostered scientific investigation, and contributed himself. To phytophraphy his *Registers* are important. In 1779 the first appeared, then, from 1780-1782, a *Naamlijst* was published composed of four *Registers* (2). The first sums up the plants of Batavia and surroundings. Another list contains an alphabetical index to Rumphian names with a reduction to their (supposed) Linnean equivalent. RADERMACHER had prepared the ground for phytophraphical progress; the Secretary of the Society, FREDRIK, BARON VON WURMB, made good use of it.

Arriving in 1775 from Saxony, VON WURMB proved to be a clear-eyed and cautious observer, able to describe plants with a consideration of the Linnean prescripts. In 1779 he made a note on the 'Order of the Palms', in 1780 papers on *Licuala*, *Nipa*, and *Uncaria* followed, and shortly before his death an article on *Cycas* appeared (1781), all in the 'Verhandelingen'. Among his activities was the establishment of a small botanic garden in an allotment donated by one of the Batavian members to the Society. His death (1781) was a serious blow to Malaysian phytophraphy that so recently had come to rely on an organized body of nature lovers and a durable centre: a library and a herbarium. Posthumously, some of VON WURMB's notes appeared in the 'Verhandelingen' of 1786.

Although it was stated that VON WURMB's papers were lost in the Indies after his death (3), a

book on the 'curiosities of the East Indies' appeared in 1797 (4). I have failed to trace a copy but it is reported to contain considerable contributions to Malaysian botany.

RADERMACHER's violent death (1783), following so soon after VON WURMB's, proved too much for the slender interest in botanical sciences. An order issued to all officers of the Company (1795) in the Outer Possessions to forward seeds and plants of all trees which might be useful to experiment with in Java, while they 'had to be accompanied by a description' was neglected. Phytophraphy in the Dutch East Indies had to wait for new designed, progressive efforts till the opening years of the 19th century.

*References:* (1) VAN HOUTEN, in Bull. Kol. Mus. Haarlem 34 (1906) 71-76. (2) RADERMACHER, Register der geslagen in Verh. Bat. Gen. 1 (1779) 87-110. (3) VON WURMB & VON WOLLZOGEN, Briefe . . . auf ihren Reisen . . . Ostindien 1774-1792 (1794). (4) VON WURMB, Merkwürdigkeiten aus Ostindien (1797).

### 39. *Incidental contributors in Malaysia; De Noronha*

VON WURMB, as a student of the Java flora, was to some degree succeeded by C. F. HORNSTEDT, a pupil of THUNBERG's; he was paid by the Society in 1783 and 1784. Returning soon to Europe, he wrote a doctor's thesis on Javan edible fruits (1).

An effort to revive the grisly stories of the Upas Tree was made by N. P. FOERSCH (2), surgeon of the Company at Batavia and/or Semarang (c. 1774) which miscarried but had, unwillingly, the merit that the tree was now demonstrated to grow in Java, and that these fabulous rumours made LESCHENAULT, HORSFIELD, and later authors, write detectable and exhaustive studies on this interesting plant (3).

F. DE NORONHA, a Spaniard who had worked for some time in the ancient Botanic Garden at Manila—nothing more is known about this garden which must have existed about 1790 and may have been established by J. DE CUELLAR (4)—came to Java in 1786 and, with Government support, penetrated into the interior as far as the eastern spurs of the Kendang mountains. His draughtsman made a set of more than 111 coloured figures (his extreme secrecy about his botanical investigations induced a secret copying of his plates so that more than one set exists), and his results were embodied in three papers, one (in honour of Governor-General W. A. ALTING, who promoted his studies) on *Altingia* (5), the second on *Gluta renghas* (6), and the third a list of Javan plant names with their Latin denominations (7). These *nomina nuda* drew the attention of botanists (he was the first trained botanist to penetrate into the interior of Java with the purpose of collecting plants and to ascend a Javan mountain) and HASSKARL wrote a list of, what he thought might be, the scientific equivalent names. A thorough study by BACKER and VAN STEENIS has been prepared and contains a study of his plates which had never been identified



HENDERSON



HEYNE



HOCHREUTINER



HOLTUM

and 'have a unique historical value'. In 1787, DE NORONHA left suddenly for Mauritius, taking with him all his Philippine and Malaysian collections, to die there in the next year. His collections have disappeared but his MSS are preserved at Paris. He had planned to write a 'Flora Javana'.

*References:* (1) HORNSTEDT, *Fructus Javæ esculenti* (1786). (2) FOERSCH, in *London Mag.* (1783), also *Alg. Vaderl. Letteroef.* (1784). (3) for liter. on *Antiaris* see GRESHOFF, *Nuttige Ind. Pl.* (1894). (4) *Fl. Mal. I*, 1 (1950) 120. (5) *Verh. Bat. Gen. 5* (1790) 1–20. (6) *ibid.* p. 1–9. (7) *ibid.* p. 1–28.

#### 40. *Raffles and Horsfield*

An order of the Company in the closing years of the 18th century to re-activate the study of economic plants had no effect but the wish to renew phytographical and botanical research was most happily fulfilled when TH. HORSFIELD, after a first visit to Batavia in 1800, returned in 1801 and resolved to study the natural history of the island. Elected as a member of the Batavian Society while obtaining the post of Army surgeon, the American was charged to search after indigenous medicinal plants.

After preliminary work in the Buitenzorg district and West Java, he travelled extensively in Central and East Java, with brief intervals till 1811, accompanied by draughtsmen and securing a large herbarium (1); important botanical discoveries were made in the mountains which had been so rarely visited by botanists before him. The Javan mountain flora was now shown to include many genera characteristic of the temperate climatic zones.

He intended to write a 'Flora Javana' but this, like so many earlier efforts by others, did not materialize. Volume 7 of the 'Verhandelingen' (1814) has, in addition to the narrative of his travels, studies on *Antiaris*, *Crinum asiaticum* L., *Inocarpus edulis* FORST., and *Sapindus rarak* L. He shows himself an enthusiastic botanist, but now and then a lack of training betrays itself.

RAFFLES, temporarily in charge of affairs in the Indies and determined to let the British empire profit whenever possible, succeeded in attaching HORSFIELD to his train. An investigation of *Banka* started but, after some time, HORSFIELD barely es-

caped with his life; his herbarium was lost but, returning after some months to Soerakarta, he gave a fine *Account of Banka* (1817). RAFFLES made HORSFIELD acquainted with BANKS and his eminent secretary R. BROWN; co-operation was the result. New exploratory trips in Java were undertaken but, before RAFFLES left and the island was restored to the Dutch, it was arranged that all HORSFIELD's specimens would be dispatched to England. In 1818 he left for Bencoolen, shipping his herbarium at Semarang, and investigated the SW. Sumatran region together with RAFFLES. A last visit was paid to Java, then he left for London being appointed Assistant in the Museum of the East India Company, where he remained till his death (1859). His personal phytographical contributions are small but his collections, especially those of eastern Java, of particular importance. From 1838–1852 appeared a beautiful volume *Plantae Javanicae Rariores* by R. BROWN and J. J. BENNETT. The book is, apart from its fine illustrations, a series of carefully written essays, most readable and phytographically as well as historically a classic. BROWN directed the drawing, analysed and described. BENNETT was in particular entrusted with the habit description, the history, and the surveys of literature. Written in the quiet mood necessary for the understanding of plants, the studies in *Podocarpus*, *Antiaris*, *Cyrtandra*, *Dialium*, and *Sterculiaceae* make fascinating reading. *Plantae Javanicae rariores* is one of the best books on Javan plants; it contains many new names and rare records. The colours of the plates are not always exact, as these had to be determined from the collector's notes, from memory, and dried materials, but similar small slips occur also in BLUME's and KORTHALS's coloured plates (cf. §§ 47, 51). HORSFIELD's plants were also treated in MIQUEL's *Flora Indiae Batavae*, to which they were to provide an indispensable source of data.

R. BROWN's other works, dealing directly or indirectly with Malaysian plants, will be indicated in § 49.

BENNETT was BROWN's lifelong friend and assistant, succeeding him at his death (1858) as Keeper of the Botanical Department in the British Museum.

*References:* (1) BENNETT & BROWN, Preface to *Plantae As. rar.* (1838–1852).

41. *Father de Loureiro's 'Flora Cochinchinensis'*

The *Flora Cochinchinensis* by Father JOÃO DE LOUREIRO S.J. (2 vols, 1790) is the only 18th century work on the flora of Cochinchina that is of importance to Malaysia; it was re-edited by C. L. WILLDENOW in 1793.

LOUREIRO's other publications (apart from a study on epiphytes in 1799) are insignificant botanically but large manuscripts and volumes of drawings are preserved at Lisbon. In 1935, MERRILL wrote an extensive study and an interpretation (1) of *Flora Cochinchinensis*, and estimated that it contained c. 1150 species, among which were 630 new at that time, and 185 new genera. He judges its phytophraphical contents in this manner: "Many of his descriptions are excellent, in fact distinctly superior to . . . many . . . prepared by LOUREIRO's contemporaries in Europe. In other cases they are short, incomplete, indefinite, and sometimes very inaccurate." LOUREIRO's Herbarium is preserved in the British Museum.

References: (1) Am. Philos. Soc. Trans. new ser. 24<sup>2</sup> (1935) 1-445.

42. *Indian research; the 'United Brotherhood', Roxburgh*

Botanical studies were, in India, mainly pursued by the 'United Brotherhood', a society founded by J. G. KOENIG (of the Danish settlement at Tranquebar), counting among its members B. HEYNE, KLEIN, and J. P. ROTTLE. An indefatigable traveller and collector, KOENIG, a pupil of LINNAEUS, made the first exhaustive descriptions of species of Malaysian *Scitamineae* and of a number of *Orchidaceae*; his main articles were published (1) by RETZ (1779). He seems to have worked to his satisfaction in the botanical garden of C. DE VENDT in Malacca. Planning new travel, he died in 1782 at Tranquebar. Many of his observations on plants belonging to other families are contained in a paper by Sir WILLIAM JONES, published (2) posthumously in 1795.

HEYNE, a Moravian missionary, surgeon and botanist in the service of the Company, sailed in 1777 to Madras. He was in charge of the spice gardens and in 1812, when leaving for Europe, he spent five weeks in Pulu Tikus—'Rat Island', near Bencoolen—where he collected about 70 species of plants. A. W. ROTH, at Bremen, identified these but the 'Catalogue of the Flora of Rat Island' was lost. A considerable work (3) by the same author on HEYNE's plants is very largely based on Indian materials only (1821). ROTTLE's description of the Madras region was edited (4) and annotated by C. L. WILLDENOW (1803).

In these years of rapid and often brilliant progress in British India, W. ROXBURGH, the most productive of the 'United Brotherhood', wrote or prepared a number of exceptionally important phytophraphical works; he is referred to as the 'Father of Indian Botany'.

Being appointed in the Company's Medical Establishment at Madras in 1776, he explored the

interior towards the North and gathered the materials which, with KOENIG's notes, would form his 3-volumed *The Plants of Coromandel* (1795-1819), issued in coloured and uncoloured copies. His transfer to Calcutta, succeeding KYD as superintendent of Calcutta Gardens (1793), made him plan a flora of a wider scope but, on his return on account of ill health to Europe (1813, died 1815), nothing had been published. He left more than 2500 coloured pictures and vast manuscripts to the care of one of his successors at Calcutta, W. CAREY. First appeared *Hortus Bengalensis* (1814), an enumeration of plants cultivated at Calcutta with very scant phytophraphical details (both ROBINSON (§ 21) and ALSTON (§ 20) studied (5) the nomenclatural standing of the names); this was followed by a volume of *Flora Indica* in 1820, followed by a second part in 1824. This first volume was re-issued together with two additional volumes in 1832 which incorporated many of N. WALLICH's notes ('CAREY's edition'). In 1874 a reprint of CAREY's edition was issued through the care of C. B. CLARKE. In *Flora Indica* many species from the Moluccas, collected by English sailors, were described for the first time.

References: (1) J. G. KOENIG in RETZ, Obs. Bot. 3, 6. (2) As. Res. 4 (1795) 237-312. (3) ROTH, Novae plant. species (1821). (4) WILLDENOW on ROTTLE, Ges. Naturfr. Berlin, neue Schr. 4 (1803) 180-224. (5) ROBINSON, Philip. J. Sci. Bot. 7 (1912) 411-419; ALSTON in Ann. Roy. Bot. Gard. Perad. 11 (1930) 299, Fl. Ceyl. Suppl. 6 (1931) and MS.

43. *Penang Gardens*

In Penang Island, a botanical garden developed from spice gardens. The first (1800-1805) was followed (RAFFLES) by a second (1822-1826), and a third. Originally, this was a forest nursery but CH. CURTIS succeeded in rising it to a famed botanical garden of which he became the first Curator (1884-1902). Their influence on and the opportunities they offered to Malaysian phytophraphy have been considerable in this and in later periods. W. ROXBURGH's son and namesake collected plants in Penang in 1802. W. HUNTER, apart from papers on pepper (1) and gambir (2), catalogued the Penang plants about this time; his manuscript was published in 1909 by H. N. RIDLEY (3).

Penang Gardens were made over to the administration of the Municipality of Georgetown (1910) and MOHAMED HANIFF, a widely known plant collector, was put in charge. In 1912 it was returned to the Singapore Gardens. R. E. HOLTUM described this 'Waterfall Garden' in his *Guide* of 1934. The Penang Herbarium, built up by CURTIS, and enlarged by the collections of dozens of botanists, is kept at Singapore.

References: (1) As. Res. (1803). (2) Trans. Linn. Soc. (1807). (3) Journ. As. Soc. Str. Br. 53 (1909).

44. *Philippine phytophraphy*

The most conspicuous event in the Philippines in these years, after P. SONNERAT's Luzon collections

(1771), was the visit of the corvette 'Descubierta' under A. MALASPINA, a Spanish scientific expedition round the world (1789-1794).

TH. HAENKE and L. NÉE made large collections which were sent to Spain, where an unfavourable state of affairs caused the herbarium to be stored under bad conditions till 1818. HAENKE's plants—in so far as they were saved—arrived in 1821 at Prague, and were partly elaborated by C. B. PRESL in *Reliquiae Haenkeanae* (1825). The history of this herbarium explains why several South American plants were believed to occur in the Philippines,

the authors being led into error by mislaid labels. PRESL published large studies on Ferns generally.

From this period date many references to Philippine plants which are contained in DE NORONHA's unpublished manuscripts, Dr VAN STEENIS informs me (*cf.* § 39).

The Romanzoff Pacific expedition on the 'Rurik' stayed off Luzon (1817-1818); A. VON CHAMISSE collected in the Philippines and published on these with D. VON SCHLECHTENDAL (1826-1836) in 'Linnaea'.

## FROM THE ESTABLISHMENT OF THE BOTANIC GARDENS AT BUITENZORG (1817) TILL THE DEATH OF SCHEFFER (1880)

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### 45. 19th century standard works; De Candolle, Bentham & Hooker, and contemporaries

The period between 1816 (restoration of Dutch sovereignty in the major part of the Archipelago) and 1880, the year of SCHEFFER's death, embraces the larger and middle part of the 19th century, *i.e.* the fast and splendid rise of the natural sciences. Phyto-graphy and botany in general gradually could draw from comprehensive descriptive studies, and came to rely on new directions for, or methods of, description which resulted in books vastly more reliable, accessible, and fruitful than any earlier publication.

The 19th century was the age of standard works, often of a thoroughness and covering so wide a field, as was rarely attempted in the 20th. The following is a rough picture of the main authors and books which left an imprint on Malaysian phyto-graphy.

A. P. DE CANDOLLE, in 1813, by his *Théorie élémentaire* opened the new era by his method of applying the principle of conformity when evaluating morphological characters. Born at Geneva (1778), he collaborated in his earlier years with LAMARCK; together they edited a 3rd edition of the *Flore Française*. In the first volumes, LAMARCK brought his ingenious invention of the dichotomous key into effect (see § 30). LAMARCK also at-

tached new meanings and fresh accents to rudimentary or abortive organs. DE CANDOLLE, adding his brilliant gifts and inexhaustible capacity for work to the latter's principles, and basing his studies on the French school (the family conception of the DE JUSSIEUS, the monocotyledons, acotyledons and pluricotyledons distinguished by R. L. DESFONTAINES as morphologically distinct groups), made Geneva into a main centre of phyto-graphy after he had returned to his native town as soon as it was wrested from Napoleon's grip (1814).

In 1818, there appeared his *Regni vegetabilis systema naturale*, as a bold attempt to emulate *Species Plantarum*, while describing the species in the new French style; a second volume (1821) followed, but by then the enormous demands of the undertaking made it clear that it was bound to remain unfinished. A shorter manner of treatment was chosen: *Prodromus systematis naturalis*. When DE CANDOLLE died (1841), of the 195 recognized families 102 had been completed, including the *Compositae*. The happy collaboration with his son ALPHONSE (who brought the *Prodromus* to completion, vol. 17, 1873) was reflected in ALPHONSE's collaboration with his son, CASIMIR, which resulted in the *Monographiae Phanerogamarum* or *Suites au Prodrome* (with several collaborators, 9 volumes, 1878-1896). Among A. DE CANDOLLE's other works I note *La Phyto-graphie* (1880) of unusual interest





J. D. HOOKER



JUNGKUHNS



A. L. DE JUSSIEU



KING

and containing an important list of herbaria and collections, and his classical *Origine des plantes cultivées* (1883).

General German works which put their mark on Malaysian phytography are J. J. ROEMER and J. A. SCHULTES's 16th edition of LINNAEUS's *Systema vegetabilium*, ed. nova (1817-1830), C. H. PERSON'S *Synopsis Plantarum* (5 vols, 1817-1821), C. SPRENGEL'S editions of LINNAEUS's *Systema vegetabilium* (1826) and of *Genera Plantarum* (1830-1831), S. ENDLICHER and E. FENZL'S masterly *Genera Plantarum* (1836-1840), a synoptical descriptive treatment of all known genera according to a natural system, the contemporary *Plantarum Vascularum Genera* by C. F. MEISNER (1836-1843), and W. G. WALPERS'S *Repertorium botanicae systematicae* (4 vols, 1842-1848), followed by *Annales botanices systematicae* (1). The second edition of E. G. STEUDEL'S *Nomenclator botanicus* (2 vols, 1840-1841) may be seen as a further approach to the future *Index Kewensis* (§ 9).

G. W. BISCHOFF'S *Handbuch der botanischen Terminologie* (3 vols, 1833-1844) and his *Wörterbuch* of 1857 (2nd ed.), proved of the highest value to phytography as it led to a closer and unambiguous interpretation of botanical terms. Time made G. A. PRITZEL'S *Thesaurus literaturae botanicae* (1st ed. 1851), of which the much improved 2nd edition appeared in 1872, to a bibliographical classic and an invaluable source of references. His *Icones botanicae Index* (2 vols, 1855-1866) is now superseded by *Index Londinensis*.

The British contributed by G. DON'S *General History* (4 vols, 1831-1838), intended as a new and improved edition of PH. MILLER'S *Gardener's Dictionary*. G. BENTHAM and J. D. HOOKER wrote *Genera Plantarum* (3 vols, 1862-1883), a lasting monument to the genius of its authors and so universally marking the concept of the limits of natural genera and the trend of plant phylogeny that, also in Malaysian phytography, studies may be separated into groups before and after the publication of *Genera Plantarum*.

In France, appeared H. E. BAILLON'S *Histoire des Plantes* (1870-1895), in the wake of *Genera Plantarum* less noticed than it deserved. Its qualities assured it, however, a place as a work of reference and authority, though it came too late (1870-1895) to

influence Malaysian phytography in this period to a large extent.

Holland did not produce any work of a scope comparable to those just mentioned. In this period, a comparatively large number of the Dutch phytographers either stayed in Malaysia or devoted their time to the study of its flora at home. Many works appeared, dealing with the Malaysian flora as a whole or confined to a portion of it. Often, as regards contents, manner of treatment, and execution, they could easily stand comparison with the best work of a similar character written outside the boundaries of our empire.

*References:* (1) WALPERS, Ann. bot. system. 7 vols (1848-1868), vols 4 & 5 with K. MUELLER, vols 6 & 7 by K. MUELLER.

#### 46. Reinwardt and the Buitenzorg Gardens

After the English interregnum of Java which stimulated research in some fields of natural sciences, the Dutch Government, on being restored to power, decided to follow this lead and among the Commissaries to take over, one was appointed and given full authority to promote a scientific development of the colonies.

This first emissary of the Government representing the learned world in Holland, was C. G. C. REINWARDT, Director of Agriculture, Arts, and Sciences in Java and adjoining Islands, who arrived with Commissary-general G. A. G. P. VAN DER CAPELLEN on April 27, 1816, off Batavia.

Being 43 years old, he had gained repute as a capable versatile scientist; he was entrusted with the care of practically all aspects of natural sciences, education, and ethnography. It is worthy of notice that among so many tasks no mention is made of a botanical garden and, therefore, REINWARDT'S initiative and insight are to be thanked that, a year after his arrival, a piece of waste ground adjacent to the old Palace Garden at Buitenzorg was turned into a garden where plants could be kept both for scientific and economic purposes (May 18th, 1817). From that moment, Malaysian phytography had found its natural centre and, in the course of time, pharmacology, forestry, horticulture, agriculture, and in brief, all botanical science in Malaysia were to reap from the

abundant harvest of data and materials provided by the Buitenzorg Botanic Gardens, now a cherished and envied proof of Dutch progressive effort in the tropics and an example of harmonious international co-operation, and then again a neglected and starved remnant of former glory, but always surviving through its true virtue.

REINWARDT, in the opening years of the Gardens, was assisted by the garden intendents W. KENT (who had served under him in the same capacity during his professorship at Harderwijk), and J. HOOPER, of Kew Gardens. Botanical draughtsmen were A. J. BIK and J. TH. BIK. Although REINWARDT executed his commission with unabating industry, collecting plants on his official tours (many were lost by shipwreck; for his manuscripts see also DE VRIESE, § 48), and was an able organizer and outstanding teacher, he himself added only modestly to phytography. In 1822 he returned to Holland, to occupy the Chair of Botany at Leyden till 1845. His main phytographical publications are on polyembryony in *Mangifera* (1) and *Sylloge plantarum novarum indicarum* (1825–1826), published on the request of his friend F. HORNSCHUCH, with whom he wrote the first paper in history on Javan mosses (1826), with coloured plates by J. STURM and preceded by a study of *Hepaticae Javanicae* by himself, BLUME, and E. G. NEES AB ESENBECK (1824). After THUNBERG's first publication of 3 species from Java, now 59 appeared new in print.

His address to the Berlin Academy of Sciences, *Ueber den Character der Vegetation auf den Inseln des Indischen Archipels*, though one of the earliest is not one of the most successful attempts to characterize and describe the vegetation of Malaysia in general (1828).

On REINWARDT's departure, botanical sciences in the Netherlands East Indies were entrusted to the 'Natuurkundige Commissie' (see § 50) and to BLUME, appointed Director of the Gardens at Buitenzorg in 1822.

References: (1) *Nova Acta Nat. Cur.* 12<sup>1</sup> (1824) 341–346.

#### 47. Blume

C. L. BLUME has been one of the ablest phytographers ever to work on the Malaysian flora; his works have never been surpassed in this field, as regards technical execution (printing and reproduction) and boldness of conception. Objections have been made against BLUME's disposition to monopolize all materials (both collections and manuscripts) he could lay hands on in his official capacities, but it cannot be denied that botany (and phytography in particular) thrived through his zeal for productive research and his proud ambition to achieve more and better than any previous or contemporary author. Much would have remained obscure or be forgotten till the present day that was brought to light by his, admittedly not always considerate, endeavour.

Born in 1796 (at Brunswick in Germany), he reached Java in 1818, charged with the medical

supervision of vaccination. Soon after he joined REINWARDT as his 'adjunct Director for Agricultural Affairs' and after REINWARDT's departure (1822) accepted appointment as Director of the Buitenzorg Botanic Gardens. BLUME started to collect vigorously and, in the course of time, travelled in many parts of West and Central Java.

BLUME first published (1823) a *Catalogus van 's Lands Plantentuin*, listing more than 900 species (of which more than 300 were denoted by REINWARDT in manuscript); the Linnean classification is followed and brief Latin diagnostic descriptions accompany the new names. In 1823 he gave the botanical report of an ascent of Mt Salak (descriptions especially of *Magnoliaceae*, *Meliaceae*, and *Loranthaceae*); its counterpart, a report of a trip to Mt Gedeh, appeared in 1825. Of first importance to all later studies on Malaysian *Fagaceae* was his *Bijdrage tot de kennis onzer Javaansche eiken* (1825). In these years fall his studies on *Rafflesiaceae*, and his *Bijdragen*, a series of great interest consisting of 17 fascicles (the 6th fascicle being supplemented by *Tabellen en platen voor de Javaansche Orchideen*), published in 1825 and 1826. The *Bijdragen* have descriptions of hundreds of new species ( $\pm 1200$  spp. are described in all) and are based on REINWARDT, KUHLE, and VAN HASSELT's specimens and notes (§ 50) and on his own collections made in 1823 and 1824. A. J. BIK and LATOUR were his draughtsmen but their work was published much later. The *Bijdragen*—partly issued after BLUME had returned to Europe (1826)—appear to have been hurried. Reference to literature is, and could be, scarcely made, it is hardly attempted to contrast the species with each other, and the phytography, though suggesting the author's ability, is not quite up to the mark. A monograph on East Indian pepper species (1826) was last to appear in Java (1).

BLUME took with him much that had been secured so far—either by himself or by contemporaries—and this herbarium formed the nucleus of all future Malaysian collections of the 's Rijks Herbarium' (National Herbarium) to which BLUME was appointed Director on its establishment at Brussels in 1829.

It has been asserted that BLUME took with him to Holland all herbarium present at Buitenzorg. He left there, on the contrary, a large set of several thousands of duplicate authentic specimens, a valuable collection which, it would seem, was not regarded as such. A remarkable coincidence proved BLUME's intention of providing Buitenzorg with an efficient foundation for future systematic study. In 1837, a collection of Javan plants was offered him for sale which proved to be the duplicate set he had left behind (2).

In 1830 the 's Rijks Herbarium' was moved to Leyden and combined with the 'Academisch Herbarium'.

In 1827–1828, BLUME had had printed an *Enumeratio* of the Javan species (a work insufficiently considered by many later authors) and then, in collaboration with J. B. FISHER, he began his magnificent *Flora Javæ*, in folio, with 238 coloured plates

which surpassed all earlier published pictures. Draughtsmen were LATOUR, ARCKENHAUSEN, VIVIEN, SIXTUS and, eventually, BLUME himself. The book was also issued in an uncoloured edition. From 1828, parts of the work appeared (3). In 1830 the work halted with the 3rd volume and was not resumed till 1847; the second volume was entirely devoted to Ferns.

A variety of papers, some of them written with remarkable skill, appeared in the scientific periodicals of the following years (e.g. on *Aspidistra*, and the establishment of the family of 'Gneteeae'). Largely at BLUME's own expense, between 1835 and 1845, another serial work was published: *Rumphia*. The coloured plates (c. 200 in 4 volumes) are beautiful but do not equal those of *Flora Javae*. *Rumphia* was written somewhat in the spirit of international co-operation, in particular the French helped considerably (B. DELESSERT, A. DE JUSSIEU, A. BRONGNIART, and in particular J. DECAISNE). The 2nd and 3rd volumes contain extensive phytographical work on the Palms by BLUME; his systematical arrangement has been criticized. The plant pictures were drawn by VAN OORT, BIK, and LATOUR; the landscapes by others.

The years 1849 and 1850 are characterized by violent quarrels with other botanists, especially with F. JUNGHUHN (cf. § 52) and W. H. DE VRIESE (cf. § 48). As the point of issue is of phytographical interest, I may be excused to refer briefly to these unfortunate incidents.

JUNGHUHN believed to have made a first rate discovery in Sumatra. He had collected specimens of a *Dacrydium*, a conifer, having twigs densely covered by flattened awl-shaped leaves (1842). When hastily travelling in the mountains, he had secured some branchlets of the big tree and provisionally named it 'Lycopodium' on the label. The mistake was published by unsuspecting colleagues and so JUNGHUHN's 'tree-like Lycopodium' appeared in print.

BLUME, sensing some mistake inquired whether DE VRIESE, who had access to JUNGHUHN's Herbarium, which BLUME had not, agreed to JUNGHUHN's views, and DE VRIESE unwisely replied, without investigating the matter, that he did.

In the third volume of *Rumphia* (1849), BLUME broadly announced his discovery that the 'Lycopodium' should rightly be a *Dacrydium* and this was accompanied by a honied commentary which cast a somewhat peculiar light on JUNGHUHN and DE VRIESE's abilities as botanists.

From these small beginnings, the controversy grew to large proportions, and I must refer the reader to examine the publications dealing with the incident, if he feels inclined to do so; no phytography was involved after this first stage (4).

The *Museum Botanicum Lugduno-Batavorum* (vol. 1, 1849-1851, vol. 2, 1856) is decidedly the least attractive among BLUME's works. It contains hundreds of uncritical descriptions, and being largely without illustration, its contents are often rather perturbing to the systematist confronted with the task of settling the true status of the names. In these years occurred the issue of *Mélanges bo-*

*taniques* (I in 1855, II in ? 1856), a very rare publication, in which a new taxonomical arrangement of Malaysian *Rosaceae* was proposed. In 1858, a new series of *Flora Javae* was begun but ended with the completion of volume 1, a volume entirely devoted to Malaysian orchids. Soon after his death (1862) at Leyden, sets of 23 unissued coloured plates *Planches Inédites* without text, were offered for sale by his publishers (3).

*References:* Verh. Bat. Gen. K. & W. 11 (1826) 139-245. (2) VAN STEENIS in Bull. Bot. Gard. Buitenzorg 18 (1949). (3) Blumea 3<sup>2</sup> (1939) 203-211; VAN STEENIS in Fl. Mal. Bull. no 2 (1947) 49. (4) JUNGHUHN, Inlichtingen aangeboden . . . over zeker geschrift in Alg. Konst & Letterb. 41 (1850), Over den boom Sambinoer op Sumatra in Ned. Kruidk. Arch. 2 (1850) 261-278; DE VRIESE, in *ibid.* 2<sup>2</sup> (1850) 1-16, also in Ned. Kruidk. Arch. 2 (1850) 139-143; BLUME, Opheldering van de inlichtingen (1850), Antwoord aan De Vriese (1850); HASSKARL, Antwoord aan den Heer C. L. Blume (1850).

#### 48. Miquel and De Vriese

The first comprehensive flora of Malaysia was *Flora Indiae Batavae* by F. A. W. MIQUEL, professor of Botany at Amsterdam (1846-1859), Utrecht (1859-1871), and Director of the Leyden National Herbarium ('s Rijksherbarium') from 1862 till his death in 1871. Of French parentage, born in Germany (1811), he studied in Holland, his work being strikingly successful. Early publications on the botany of the ancients, on medicinal plants, and on other subjects (1834-1838) he followed up by research into Malaysian plants, and papers appeared (1) on *Piperaceae* (1839-40, 1843), *Casuarina* (1840), and monographs on *Cinnamon* (1841) and on *Cycadaceae* (1843). Notes and papers of various importance were collected in his *Analecta botanica Indica* (1850-1852). His editorship of *Plantae Junghuhnianae* (1853-1856)—many revisions of JUNGHUHN's plants he elaborated himself—lasted while his *Flora Indiae Batavae* began to come from the press (1855-1859), partly written in Latin and partly in Dutch. MIQUEL delimits his region towards the West by the Andamans and Nicobars, to the East it included West New Guinea; he is uncertain about the Philippines although in his *Flora* these are considered consistently. While advocating a wide species concept, MIQUEL was cautious in rejecting species even if he failed to establish clear reasons from literature for preservation. He was thoroughly aware of the high desirability of observing plants living in their natural surroundings in order to judge their morphological potentialities which is an invaluable aid when studying herbarium materials. This is demonstrated by his reproach to botanists 'who derived all their knowledge from dry specimens'. Yet, he himself had very little else at hand.

It is a remarkable fact that MIQUEL, when writing his *Flora Indiae Batavae*, had no materials from Leyden (BLUME!) at his disposal. The work is based, first of all, on the JUNGHUHN, ZOLLINGER, and HORSFIELD collections, moreover, he received



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large, and valuable, consignments from Buitenzorg, assembled by TEYSMANN and by HASSKARL. (cf. § 53). The Paris Herbarium gave assistance.

The authentic specimens of BLUME, KUHL & VAN HASSELT, ZIPELIUS, SPANOGHE, KORTHALS and others preserved in the Rijksherbarium, came only within reach when he became its Director after BLUME's death (1862), and in his main work MIQUEL had to be satisfied, in hundreds of cases, with copying the species descriptions from earlier literature.

MIQUEL's wish for completeness induced him to base the descriptions of a number of new species on deficient specimens but, on the whole, the unavoidable errors, typical of describing botanists who are unacquainted with the living tropical vegetation (MIQUEL never visited the tropics), are rather few and this, added to the careful compilation of previous literature, made MIQUEL's *Flora* a greatly appreciated and most useful book. More than 9000 species of Phanerogams are described, a considerable number of genera and species new.

The frequent new finds during further exploration in the Archipelago made it apparent that 'completeness' had scarcely been approached. A *Supplementum I* to the *Flora* was published under the title *Prodromus Florae Sumatranæ* (1860–1861) which contained more than 1300 species descriptions, more than half new and to a large extent based on TEYSMANN's, and his relation DIEPENHORST's, collections. This latter work is not up to the standard of the *Flora Indiae Batavae*, but has an important essay on the botany of Sumatra. MIQUEL's final term of office (as BLUME's successor in the Rijksherbarium) is remembered in Malaysian phytophotography by his *Annales Musei botanici Lugduno-Batavi* (4 vols, 1863–1869). These contain a series of critical revisions, the majority of MIQUEL's hand. His death (1871) interrupted the publication of the *Illustrations de la Flore de l'Archipel Indien* after 2 fascicles had appeared in 1870; W. F. R. SURINGAR published a 3rd fascicle some months after his death. Only two pupils of MIQUEL's published on the Malaysian Flora: P. DE BOER on Conifers (2), which remained his only contribution, and R. H. C. C. SCHEFFER who was destined to further greatly the progress of Malaysian phytophotography (see § 55).

When MIQUEL began work at Leyden, study of the botany of Malaysia (in particular its phytophotography), was an established tradition there. Besides C. L. BLUME's splendid publications, there appeared W. H. DE VRIESE's works, more modestly edited but not to be overlooked.

DE VRIESE, taking an active part in editing the botanical periodicals of the time (3), spent much of his energy for horticultural purposes but, fired by the steady and fast developments in the knowledge of Malaysia's flora, published more and more descriptive studies.

From his writings one gains the impression that he was a cautious and critical observer and it is to be deplored that his scattered interests in several branches of botany prevented his writing more comprehensive studies. His texts are always well built, and his phytophotography results in close and thorough plant portraits. In particular there may be referred to: *Plantarum Javanicarum minus cognitarum . . . sylloge* (4), *Descriptions et figures des plantes nouvelles et rares du Jardin Botanique de Leyde* (1847–1851), *Marattiaceae Indiae Batavae* (5), *Illustrations d'Orchidées des Indes orientales Néerlandaises* (1854), *Illustrations des Rafflesias Ruchussenii et Patma* (1854), *Mémoire sur le Camphrier de Sumatra et Borneo* (1856) and, of foremost importance, his books on REINWARDT's life (6) and collections (7). He was REINWARDT's successor to the Chair of Botany at Leyden and edited *Tuinbouw-Flora van Nederland en zijne overzeesche bezittingen*, &c. (3 vols, 1855–1856).

The unexplored treasures of the Malaysian vegetation attracted him so strongly, that he decided to make a trip to the East Indies. Meeting Garden Superintendent TEYSMANN at Buitenzorg, he travelled with him in many parts of the Archipelago and secured fine collections from Java, Sumatra, Borneo, Celebes, and the Moluccas (1860). Seriously ill, he returned to Holland and died soon after arrival (1861); his plants were studied by MIQUEL and others.

REINWARDT, after his fruitful work in the East Indies (see § 46), occupied the Chair of Botany at Leyden (1822–1845), while DE VRIESE held a similar post at Amsterdam (1834–1845). He succeeded REINWARDT at Leyden (1845–1861). BLUME, first Director of the Rijks Herbarium (1828–1862) was

succeeded by MIQUEL (1862–1871). W. F. R. SURINGAR replaced de VRIESE and, when MIQUEL died, received an additional appointment as Director of the Rijksherbarium. This implied that two functions of first importance to Malaysian phytophagy were now entrusted to one person and as SURINGAR devoted his considerable talents to other fields of botany, the descriptive work on the Malaysian flora fell into neglect. Only gradually the interest in Malaysian phytophagy regained its former position at Leyden with the result that at present it is one of the chief interests of the Rijksherbarium.

*References:* (1) MIQUEL, *Commentatio de vero Pipere cubeba* (1839); *Animadvers. in Pip. Herb. Hooker.* (1845); *Collectanea nova ad Cypad.* in *Linnaea* 19 (1847) 411–430, *ibid.* 21 (1848) 563–568. (2) DE BOER, *De coniferis Arch. Ind.* (1866). (3) DE VRIESE, *cf. Tijdschr. Nat. Gesch. & Phys.* 1–12 (1834–1845), *Tuinbouwfloora* (1855–1856), also *Ned. Kruidk. Arch.* (4) *Tijdschr. Nat. Gesch. & Phys.* 11 (1844) 336–347. (5) *Ned. Kruidk. Arch.* 3 (1851) 183–196. (6) DE VRIESE, *Reis naar het Oostel. ged. . . . door Reinwardt* (1858), with J. PIJNAPPEL. (7) DE VRIESE, *Plantae Ind. Bat. Or. quae . . . expl. Reinwardt*, fasc. 1–2 (1856–1857).

#### 49. Visiting phytophagists; Brown, various expeditions

The 19th century being—apart from the frequent attempts at comprehensive and constructive works on the floras of certain regions or on the vegetable kingdom as a whole—an exploratory age, numerous scientific expeditions or visiting botanists entered Malaysia and secured sometimes large and sometimes small collections which, again, were according to circumstances studied as a whole or partly. Some brief notes on the larger expeditions and best-known scientists must suffice here.

In 1803, some years before the beginning of the period now under discussion, R. BROWN visited Timor with FLINDERS's expedition to New Holland.

BROWN's close friendship with BANKS and his exemplary studies as librarian both to BANKS and the Linnean Society (since 1820), his work in the British Museum (since 1827), his discovery and description of the cell nucleus (1831) and further cytological and embryological research influenced the course of Malaysian phytophagy.

In § 40, I referred to his direct contributions to the plant description of our region, his exemplary work in connection with HORSFIELD's plants. His paper on *Rafflesia* (illustrated by F. BAUER) is familiar to every systematist (1); it described the amazing find of J. ARNOLD and T. S. B. RAFFLES in Sumatra when exploring Bencoolen in 1818. His *Prodromus Florae Novae Hollandiae* (1810) had much indirect bearing on Malaysia (he did not adhere to the Linnean artificial principles of classification!). It has been said that he was 'cautious to excess . . . and never propounding a view which he did not know how to prove, perhaps no naturalist ever taught so much in writing so little or made so

few statements that had to be recalled or even recast'. Phytophagically, his descriptions though short are lucid, sure of touch, and balanced.

The French nation also continued its excellent scientific endeavour; the pursuit of natural history in remote regions took place under the guidance of an exemplary seamanship. It is to be noted, however, that these world voyages only paid incidental visits to Malaysia and that in reality only small additions to our branch of science were made. L. DE FREYCINET, leading 'l'Uranie' and 'La Physicienne' round the globe (1817–1820), was accompanied by CH. GAUDICHAUD as botanist. The latter published (1826–1830) a *Botanique du Voyage*, illustrated with 120 plates among which were plants from Timor and Rawak (off New Guinea). Soon after, L. J. DUPERREY, with 'La Coquille', again sailing round the world (1822–1825), secured rich treasure. J. B. G. M. BORY DE ST VINCENT and AD. BRONGNIART elaborated the plants. The first published a *Cryptogamie* on the *Algae, Lycopodiaceae*, and Ferns (1827–1829), partly pertaining to Malaysia. BRONGNIART's volume on the Phanerogams ceased to appear in the middle of a description after a small number of families had been treated; an incomplete atlas accompanies this work (1829). The collecting had been done by R. P. LESSON and J. S. C. DUMONT D'URVILLE.

The latter was in command of 'L'Astrolabe' which explored between 1826 and 1829; during this expedition A. LESSON, nephew to R. P., collected. The botanical results were embodied in one volume out of twelve on the expedition, and consisted of a *Sertum Astrolabianum* (1834) and a *Flore de la Nouvelle-Zélande* (1832) by A. RICHARD and A. LESSON. It seems very probable that the materials collected in Malaysia were incompletely studied. In 1839, another French expedition touched at Batavia, DUMONT D'URVILLE again in command of 'l'Astrolabe' and H. JACQUINOT of 'La Zélée'; J. B. HOMBRON and JACQUINOT collected, together with DUMONT D'URVILLE and GUILLOU. The Phanerogams were elaborated by J. DECAISNE and the Cryptogams by J. F. C. MONTAGNE, in two volumes *Botanique* (1845). DECAISNE, also added the text of a small volume on the results of 'La Vénus' (1836–1839), which never entered Malaysia, to an atlas by A. DU PETIT-THOUARS (28 plates, 1846) containing pictures of some plants from Borneo and the Sulu Archipelago. A comprehensive survey of the additions to Malaysian phytophagy, published and unpublished, obtained by the French exploratory voyages of the period, might form an interesting study.

Other expeditions which gathered specimens used in Malaysian phytophagy were the English 'Sulphur', which circumnavigated the globe between 1836–1842, carrying the collector R. B. HINDS whose plants were elaborated by G. BENTHAM (1844). More important was the United States South Pacific Exploring Expedition (1838–1842) under CH. WILKES; the Pteridophytes were described by W. D. BRACKENRIDGE (2), the Mosses by SULLIVANT (3), and the Phanerogams by A. GRAY (4).

There were, for example, the Danish 'Galathea' expedition (1845–1847), the Prussian Expedition to East Asia (1858–1863; Ferns by F. A. M. KUHN and *Algae* by E. VON MARTENS (5)), the Austrian 'Novara' expedition (1857–1859), and, to conclude a summary of only the best known, the English 'Challenger' expedition (1879), with H. N. MOSELEY. MOSELEY's narrative of the voyage is botanically unimportant but his specimens were elaborated by W. B. HEMSLEY in a volume *Botany* (1884–1885). The Netherlands Geographic Society sponsored an expedition into Central Sumatra (Mt Kerintji, Djambi, Palembang) in 1877–1878; the plants collected by A. L. VAN HASSELT, the leader, were in 1884 enumerated by J. G. BOERLAGE (6).

*References:* (1) Trans. Linn. Soc. London 13 (1822) 201–234. (2) BRACKENRIDGE, U.S. Expl. Exp. Botany (Cryptog.) (1854) VII, 1–357, Atlas 1–46. (3) SULLIVANT, *ibid.* Musci (1859) 1–32. (4) GRAY, *ibid.* Phanerogamia 15 (1854) 1–777. (5) VON MARTENS, Preuss. Exp. Ost-Asien Bot. Th., Die Tange (1866) 1–152, t. 1–8. (6) BOERLAGE in VETH, Midden-Sumatra 4 (1884) 1–49.

#### 50. *The first years of the 'Natuurkundige Commissie'*

The English interregnum in Java (1811–1816), in addition to promoting the natural sciences, had made the Dutch realize that the time-honoured tradition of ranking among the foremost botanists in tropical Asia had been taken from their hands. A ready response to this challenge was the establishment of a botanical garden at Buitenzorg and, soon after in Holland, the appointment of the 'Natuurkundige Commissie'.

The 'Natuurkundige Commissie' (Board for the Natural Sciences), founded on April 20, 1820, consisted of young Drs H. KUHL and J. K. VAN HASSELT; they were to be assisted by the draughtsmen G. VAN RAALTEN and G. L. KEULTJES. Born at Hanau, KUHL was a fellow citizen of RUMPF's, whereas VAN HASSELT was native of the Dutch town of Doesburg. They entertained a friendship of long standing and had a vigorous desire for research in common, both being equally well equipped for fruitful work. M. GRESHOFF's stirring account (1903) of their self-denying efforts in Java ought to be consulted for further particulars (1); here I note only that they, sacrificing their lives in unremitting strenuous expeditions (1820 onwards), amassed a large and valuable, annotated, herbarium in western Java. KUHL died 9 months after arriving, VAN HASSELT prepared manuscripts (e.g. on *Orchidaceae* and *Asclepiadaceae*, partly edited posthumously by J. G. S. VAN BREDa, 1827–29), wrote a monograph of higher fungi containing 158 new species (unpublished), and continued exploration (in later years helped by J. TH. BIK) until death put an end to his, I may say, heroic endeavour (1823).

New appointments replenished the ranks of the 'Natuurkundige Commissie'; as regards contributors to phytography, A. ZIPELIUS ought to be remembered for his important exploratory work and

collections. ZIPELIUS (not ZIPPEN nor ZIPPELIUS), a horticulturist (6) born at Würzburg, had been appointed (1823) in the Buitenzorg Botanic Gardens and replaced KENT (§ 46) since 1825 as 2nd garden intendent. In 1827 he joined the 'Natuurkundige Commissie' and participated in 1828 in an expedition on the 'Triton' by way of Macassar and Ambon to the coasts of SW. New Guinea. After some months of discovery and also of great hardship, disease forced them to return. In October, Kupang on Timor was reached, where ZIPELIUS died on December 31st, 31 years old. ZIPELIUS has been characterized as an egocentric, shy personality who was nevertheless much appreciated with his companions for his integrity and unabating industry.

Of his work, very little was published, at least, so it seems. In 1826, he wrote a catalogue of the Buitenzorg Gardens, on BLUME's request, in which 3385 species were listed. After his death, his extensive manuscripts and drawings were entrusted to BLUME, who undertook to arrange and publish all that he thought fit. This never materialized and only one of ZIPELIUS's letters, dealing with the flora of Banda and the Lobo region of N. Guinea, reached the press (1829), without BLUME's intermediary (2). The manuscripts contained descriptions of hundreds of species of New Guinea, Timor, Banda, and other islands, and gradually these data were incorporated in various botanical publications (e.g. MIQUEL, SPANOGHE), also, it is assumed, in BLUME's, but it would appear that ZIPELIUS as a phytographer has not been done justice.

I wish to add a quotation from LLOYD (3) who found at Leyden "coloured drawings of a large number of Javanese fungi, and they are the best I have ever seen of tropical fungi. The name of the author of these icons has been lost, but I think I have found evidence to trace them to ZIPELIUS."

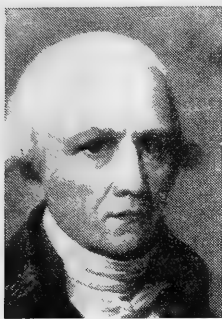
KEULTJES had died two days after KUHL; at Kupang, where the expedition of the 'Triton' stayed after ZIPELIUS's death, VAN RAALTEN died in 1829. A large portion of the New Guinea manuscripts was lost in the Chinese rebellion of 1832.

The botanical results achieved so far by the 'Natuurkundige Commissie' at so much sacrifice, apart from the several plant collections, were pitifully small. All members participated in collecting, of course, in widely different amounts and regions, but only ZIPELIUS's collection was really valuable. As regards KUHL and VAN HASSELT's botanical writings, these are to some extent incorporated in BLUME's works (cf. § 47); there is also VAN BREDa's edition of fifteen species and some general letters were published in periodicals (4). The fate of ZIPELIUS's work has been indicated above. Finally a list of plants of the New Guinea coast was composed (5) by H. C. MACKLOT, member of the 'Commissie' from 1827 till his death in 1832.

The 'Natuurkundige Commissie' needed new members and in 1830 P. W. KORTHALS was appointed to replace ZIPELIUS (see § 51).

*References:* (1) GRESHOFF, Alb. der Nat. (1903), also VAN SWINDEREN in Alg. Konst- en Letterb. (1825). (2) ZIPELIUS (ZIPPEN), Auszug eines Briefes in Flora 12<sup>1</sup> (1829) 281–287. (3) LLOYD, Meded.





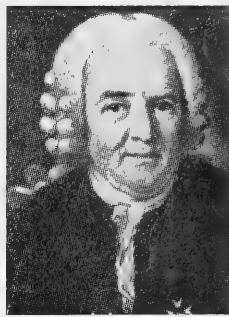
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Rijksb. 10 (1912) 1-5. (4) Alg. Konst- en Letterbode (1822<sup>1</sup>) 99-104, 149-153; *I.c.* (1823<sup>2</sup>) 130, 230, 242, 264, 341; *Ind. Mag.* 2e twaalfstal, nos 3-4 (1845) 85-91. (5) *Bijdr. Nat. Wet.* 5 (1830) 142-182. (6) VAN STEENIS in *Bull. Bot. Gard. Btztg* III, 18 (1949).

### 51. Korthals

In 1832 the Board travelled in West Java but a local rebellion resulted in the loss of much scientific material. In 1833 an expedition was made to Sumatra (Padang region) by KORTHALS and others. Returning in 1835 to Buitenzorg, KORTHALS embarked for Borneo after some minor trips in Java. He explored the river districts above Bandjermasin and penetrated into the Tanah Laut Lands. KORTHALS left in 1837 for Holland.

KORTHALS's writings are many. His style is smooth; his sentences run harmoniously, and his phrases are well considered which, together with his patient and detailed observation, makes his texts most readable. Papers of a general nature, discussing the vegetation of Java, Sumatra, and Borneo as seen on his travels, appeared in *Tijdschrift voor Natuurlijke Geschiedenis en Physiologie* (1834-36) and various other periodicals till 1854. VAN STEENIS (1) demonstrated that KORTHALS introduced into botanical literature the assumption that plants of the mountains of Java seem to occur at lower altitudes in Sumatra. Of his descriptive and systematic papers, studies in *Nepentaceae* (2), *Guttiferae* (3), *Gnetum* and *Conifers* (4), *Santalaceae* (5), *Loranthaceae* (6), and *Rubiaceae* (7) are important. His description of the peculiarities of the seedling in some *Loranthaceae* was a distinct advancement. His chef-d'œuvre, however, is the volume *Kruidekunde* of the *Verhandelingen over de Natuurlijke Geschiedenis* (1839-1847), an acknowledged classic to this day and a worthy counterpart of BENNETT and BROWN's *Plantae Javanicae Rariores*.

The *Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche Bezittingen* is a serial work embodying the studies of the 'Natuurkundige Commissie' issued under the auspices of REINWARDT, BLUME, VAN DER HOEVEN, and C. J. TEMMINCK. S. MÜLLER treated the geography and

ethnography of the New Guinea expedition in which some details on the vegetation were given, drawn from ZIPELIUS's notes, another volume was devoted to Zoology; KORTHALS is the author of the *Kruidekunde* or Botany. The latter volume appeared in a number of fascicles (1840-1844).

The book is largely based on KORTHALS's own splendid collections (some 6000 numbers), and in it no attempt was made towards a general flora. The volume is a sequence of treatments of certain groups, illustrated by coloured, ably executed, plates by J. GAUKEMA and W. T. GORDON, though many floral details and anatomical drawings are from KORTHALS's own hand. An opening chapter on *Nepenthes* has, in addition to 3 new species, a first anatomy of the curious pitchers; a chapter on *Dipterocarpaceae* contains e.g. 11 new species and particulars on wood anatomy and biology; there are equally well composed descriptions on *Leguminosae*, *Theaceae*, *Rubiaceae*, *Guttiferae*, *Hippocrateaceae*, *Tiliaceae*, *Fagaceae*, *Melastomataceae*, *Bombacaceae*, and *Rosaceae*. Considerable interest is shown here—as in numerous works of the middle decades of the 19th century—in the possibilities of plant anatomy, for it was held in high hopes that this would prove to be directive in taxonomy; R. BROWN's anatomical and cytological discoveries made this method an often adopted line of research. It has become clear, however, that though the microscopic morphology of tissues may influence taxonomical views and conceptions it represents auxiliary information. Phytochemistry, cytology, and genetics soon after their rise about the beginning of our century were similarly expected to supply decisive data to many taxonomical problems but I think that they will all be seen more and more as valuable auxiliaries to taxonomy in so far as the delimitation and relationship of systematic groups are concerned, and that they will never govern or replace the judgment and insight of the taxonomist. The vehicle common to all is descriptive morphology *i.c.* phytophagy.

Returning to KORTHALS, we find a final series of articles (e.g. on *Myrtaceae*, *Sterculiaceae*, *Magnoliaceae*, *Rubiaceae*), written about 1839 but only published in the *Nederlandsch Kruidekundig Archief* of 1846, '50, and '54. At that time he had withdrawn from botanical studies, preferring serene,



impersonal, philosophical reflection to the strife and disagreements clouding relations among the botanists of his day. In view of the excellence of his studies and his attitude towards his work, which never permitted him to lay down his pen unless he had studied and considered all aspects of the problems to the best of his knowledge and abilities, it is much to be deplored from a botanist's point of view that he spent the rest of his life remote from the science he had furthered so considerably; in 1892 he died, 84 years old.

After KORTHALS had left, the 'Natuurkundige Commissie' languished, partly because a Museum for Natural History (or Colonial Museum) founded in 1835 at Batavia, demanded time of its members (it was much too early for putting an accent on sedentary work!), partly because the wish to promote natural sciences in the Indies among leading Dutch biologists, waned. Only two members in the remaining years need mention in respect of phytography: the unfortunate E. A. FORSTEN, and F. JUNGHUHN.

FORSTEN arrived in 1838. A year passed in useless quibbles of an administrative character, though he managed to secure plants in the Buitenzorg district. In 1840 he arrived in N. Celebes where he made large collections; he also explored in the Moluccas and Ceram. A fatal illness ended his strenuous efforts, probably in 1843. Through an unforgivable neglect his manuscripts were sold at a public auction and, since then, have disappeared. His collections were never studied as a whole, they are partly in the Leyden Herbarium.

*References:* (1) VAN STEENIS in Bull. Jard. Botz. III, 13 (1933) 38. (2) Bijdr. Nat. Wet. 5 (1830) 6 pp. (3) Tijdschr. Nat. Gesch. & Phys. 3 (1836) 16–22. (4) Alg. Konst- & Letterb. 2 (1837) 290–293. (5) Verh. Bat. Gen. K. & W. 17 (1838) 187–196. (6) Tijdschr. Nat. Gesch. & Phys. 3 (1836) 187–202, also Verh. Bat. Gen. K. & W. 17 (1839) 199–288. (7) KORTHALS, Observationes de Naucleis Indicis (1839).

## 52. The final years of the 'Natuurkundige Commissie'; Junghuhn

A reorganization of the 'Natuurkundige Commissie' (1842) failed; new appointments included that of F. JUNGHUHN (for the second time) in 1844. JUNGHUHN, prototype of a solitary, restless, uncompromising, and idealistic personality, never submitted to the demands of team work. His deliberate neglect of the 'Commissie' was one of the several reasons which led to its official discontinuation in 1850.

JUNGHUHN's explorations in Java and Sumatra have become as widely known as appreciated. In 1835, he published *Topographische und naturwissenschaftliche Reisen*, a forerunner of his great work on the geography, geology, and vegetation of Java. The latter includes both the lowland and the mountain flora (between 1835 and 1848 he successively climbed all major Javan mountains), and is a result of personal observations. It bears the title: *Java, zijne gedaante, zijn plantentooi en inwendige bouw* (several editions e.g. in 4 vols, 1853–54). The

bibliographies in M. C. P. SCHMIDT (1909) and W. C. MULLER's (1910) books (1) on his life and work may be consulted for the various editions of this classic (German translation by HASSKARL, cf. § 53). and the history of the collections he secured. He was the first to collect the star of the Javan mountains: *Primula imperialis*. His descriptions of Javan plant communities far excelled all that had been attempted before and much that came after, and gave SW. Malaysian phyto-geography a first solid base. JUNGHUHN elaborated and defined for Malaysia von HUMBOLDT's scheme for the distribution of plants in altitudinal zones in S. America. Though he wrote one of the earliest accounts (1847) of the vegetation of the interior of northern Sumatra (in 1840 he had explored the Batta(k) lands where he found *Pinus merkusii*, *Dacrydium* (cf. § 47), and *Casuarina sumatrana*), he was, as a rule, not inclined to spend much time and attention to close and detailed phytography. To be noted are a paper on cryptogams (*Praemissa in Floram Cryptogamicam Javae insulae* 3)), followed in 1841 by a study in *Balanophoraceae* (4) and two on the mountain flora in general (5), in 1845. His herbarium was elaborated by a number of botanists e.g. BENTHAM, HASSKARL, MOLKENBOER, and DE VRIESE; the results were published as *Plantae Junghuhnianae* (1851–1856) which, while being edited and partly written by MIQUEL, suddenly ceased to appear for a reason unknown to me. JUNGHUHN was the discoverer of fossil plants in Java. His collection of tertiary fossils was studied (6) by H. R. GÖPPERT (1857), who wrote also on *Balanophoraceae*.

*References:* (1) SCHMIDT, Franz Junghuhn (1909), MULLER, Gedenkboek Franz Junghuhn (1910), and KROON in De Dageraad 4<sup>1</sup> (1864) 415–462. (2) JUNGHUHN, Die Battaländer auf Sumatra (1847) (3) Verh. Bat. Gen. K. & W. 17 (1839) 3–86. (4) JUNGHUHN, on Balanophora, Nova Acta 18 (1839) Suppl. 203–228. (5) JUNGHUHN, Physiognomie der toppen (1845) and Diagnoses et adumbrationes (1845). (6) Die Tertiärflora auf der Insel Java (1854), cf. also POSTHUMUS in Bull. Bot. Gard. Btzg. III, 10 (1929) 374.

## 53. The Buitenzorg Herbarium and Library; Teysmann, Hasskarl, Binnendijk, and Kurz

The Botanic Gardens at Buitenzorg under the directorship of BLUME increased both in acreage and collections though BLUME made few provisions for its improvement or future. When he left in 1826, the post of Director of the Gardens was officially discontinued. J. HOOPER, a pupil from Kew, cared for the Gardens till 1830 (when he left fatally ill for Europe) and was succeeded by J. E. TEYSMAN(N) in 1831. No eulogy of TEYSMANN's unforgettable services to phytography and botanical sciences in general is needed here; his life and work have been repeatedly described (1). The following is a brief account of his management and work. Born at Arnhem in 1808, TEYSMANN received but little schooling as a gardener. He found the Buitenzorg Gardens (1831) practically without funds and sub-

jected to the rule of the military intendent of the Palace Grounds. His only recourse was the 'Natuurkundige Commissie' who was charged to supervise his work when botanical matters were concerned. In addition to a vigorous health, an excellent memory, and a ready wit, TEYSMANN had the inestimable virtues of perseverance, common sense and an open mind. Once convinced of the desirability of certain steps or measures in the interest of the Gardens, he took care of proposals of that nature, advocated by his collaborators, as if they were his own and battled against many obstacles and the weighty opinions of authorities until a victory was won; he made the Buitenzorg Gardens earn more and more recognition as a scientific institution, until, at last, the Gardens regained their independence as a Government botanical institute of first rank (1867).

TEYSMANN retired in 1869 from the Gardens but, in recognition of his merits, was made 'Inspecteur honorair der cultures' and as such devoted his inexhaustible energy to exploratory travel and in addition to the never equalled wealth of herbarium and living specimens he had assembled, nearly to the day of his death (1882).

Between 1838-1840, TEYSMANN laid out a number of small gardens for agricultural experiments in the West Javan mountains which were the precursors of the Tjibodas Mountain Garden established in 1862.

TEYSMANN introduced hundreds of economic or ornamental plants into Java in exchange for large consignments of specimens to various countries, first of all to the Netherlands. BLUME, and P. F. VON SIEBOLD, tried repeatedly to reduce the Buitenzorg Botanic Gardens to an overseas department of the Leyden institutes (1839-1846). TREUB, the historian of the first chapters of the history of the Gardens (1) has reviewed stroke and counter-stroke of the adversaries at Leyden and at Buitenzorg. Eventually, the course of events proved abundantly that TEYSMANN had been right in his policy of defending and developing the Gardens; on the other hand, BLUME may be excused in considering that the Buitenzorg Gardens, at the time barely tolerated by the Netherlands Indian Government, provided no basis for scientific development and autonomous research. After all, the valuable collection he had left behind for the future benefit of botanists in Java, had been offered him for sale in 1837 (cf. § 47).

Apart from these clashing interests, TEYSMANN himself made good use of the opportunity to observe plants, both in the Gardens (papers on *Arenca* (2), *Lodoicea* (3), *Fourcroya* (4), *Cycas* (5), *Pisonia* (6), etc.) and on his never ending travels. Between 1853 and 1877 he explored the Archipelago in all directions either in company or alone, amassing thousands after thousands of selected specimens, a veritable treasure of the Herbarium and, till the present day, the main stock of the Gardens. TEYSMANN's plants supplied MIQUEL with excellent materials when he wrote his chief works (§ 48). His travel accounts, filled with important botanical observations, are found in many of the volumes of

the *Natuurkundig Tijdschrift voor Nederlandsch-Indië* (vol. 8-40, *passim*). His phyto-graphical work together with S. BINNENDIJK is referred to below.

The earliest of TEYSMANN's collaborators during his guardianship of the Gardens (1831-1869) was J. K. HASSKARL. From the moment of his appointment (1838) he initiated reorganizations which would add to the scientific standing of the Gardens. Within 5 years, he succeeded in rearranging the living collections into a systematic grouping, which P. DIARD, French plant explorer on Java, and Directing Member of the 'Natuurkundige Commissie' (as such more or less acting as a Director of the Buitenzorg Botanic Gardens), had suggested; the method has certain practical disadvantages but is of great educational value. HASSKARL seized the opportunity (7) of acquiring a small collection of botanical works by purchase from an estate (1842). This formed the nucleus of the future Buitenzorg Library ('Bibliotheca'), an essential to the growth of phyto-graphy.

TEYSMANN's wholehearted co-operation was not sufficient to crown with success his efforts to found a Herbarium, but after HASSKARL had returned to Europe (1843), renewed efforts from TEYSMANN succeeded and a first building for a Herbarium was erected (April 9th, 1844), a home for the phyto-graphy of Malaysia and the first purely scientific institution incorporated in the Gardens and now a worthy counterpart of the Library. HASSKARL's merit has not been acknowledged in stone but will be remembered as long as botanists study the Malaysian flora.

Of his publications on geography, physiology, etc. I select his studies in *Aroideae* (8) and the *Aantekeningen over het Nut door de bewoners van Java aan eenige planten van dat eiland toegeschreven* (1845). Phyto-graphically important are e.g. *Catalogus plantarum in horto botanico Bogoriense cultarum alter* (the first catalogue to be published (in 1844) after BLUME's, though written in 1839; it contains nearly 3000 names and was partly recast in accordance with ENDLICHER's *Genera Plantarum* and, to some extent, revised by H. ZOLLINGER, § 54). To be added are *Plantarum rariorum Horti Bogoriensis Decas prima* (9) continued in 1842 and, in the same year, supplemented by a paper (10) on *Leguminosae* (*Leguminosarum quarundum etc.*) and on other groups *Plantarum genera etc.* (11) and *Adnotationes de plantis etc.* (12).

Sailing in 1843 for Europe, he continued to publish his articles based on copious notes made from living specimens when staying in Java. In 1844, *Papilionacearum quarundum etc.* (13), *Plantarum rariorum vel minus cognitarum horti Bogoriensis pugillus novus* appeared (14). In 1845 he wrote a second *Adnotationes de plantis etc.* on Buitenzorg plants (15). After a brief return to Java (1845-'46), during which he wrote a paper on the floral morphology of *Gramineae* (16), HASSKARL continued work in Europe. On Ferns he published (17) in 1855 and '56, and on *Sapotaceae* (18) in 1855; his *Retzia, sive Observationes Botanicae* (19) appeared in 1856 (2 'Pugilli'), new genera of the Botanic Gardens followed in 1857 (20), with a



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study on *Asclepiadaceae* and *Apocynaceae* (21), and a new series of *Retzia* from 1858 to 1860 (22). To historical phytography he added e.g. by an interpretation of DE NORONHA's plants (23), his keys to *Hortus Malabaricus* (24), and to *Herbarium Amboinense* (25).

As a phytographer HASSKARL lost himself into too much detail. An attempt to create an adequate word-picture of a species was never his favourite aim, instead he preferred the reality of one or two specimens at hand and, by careful observation, added one small character to another, scarcely bothering to distinguish between major and minor points. To taxonomy this method has little value but it, at least, has the considerable merit that, when his material was good, his descriptions leave no doubt as to their correct interpretation. His original Javan herbarium was nearly entirely lost so this easy interpretation is no mean advantage and it may be said that though nearly all HASSKARL's names disappeared into synonymy (critical taxonomic research never was his best side), very few have remained a problem, while he supplied many valuable data.

Apart from his hard-won additions to the *Cinchona* (26) culture (he was again in Java from 1855 till 1856), he translated several important botanical works into German (e.g. JUNGHUHN's 'Java'), regularly published on the progress of botany in Malaysia and, basing his main publications on its specimens, he added considerably to the fame of the Buitenzorg Gardens. His final contribution to phytography was a monograph of *Commelinaceae* (27) (1870). He was a man of restless activity, often obliged by financial difficulties to do semi-scientific work but never stooping to pot-boiling. In spite of the loss of his Java Herbarium, that he had to leave behind by Government order, he assembled in Europe enormous, new, mostly non-Malaysian collections, now resting in the Leyden Herbarium, which received from HASSKARL e.g. its set of CUMING's specimens (cf. § 56).

TEYSMANN had realized HASSKARL's wishes by founding the first Herbarium and Library in the Gardens but, after HASSKARL had left, no scientist was to avail himself of these new facilities till, in 1850, S. BINNENDIJK arrived. BINNENDIJK, a practical horticulturist but gifted with a talent for phy-

tography and trained by DE VRIESE in Holland, began to write a new Catalogue together with TEYSMANN (1851) but, though the manuscript was printed (1854), it was never issued. Two copies were kept for reference at Buitenzorg, the rest being destroyed. Together they wrote on *Rafflesia* (28). Only male flowers had been described so far, they discovered the female flowers. They published on *Eusideroxylon* (29), *Euphorbiaceae* (30), and described nearly 250 new species in good fashion (31) as *Nieuwe plantensoorten in 's Lands Plantentuin te Buitenzorg* (3 instalments, 1851-'53), 20 new species of Orchids (1854), and *Plantae novae vel minus cognitae etc.* (3 instalments, 1863-'67). The third published garden catalogue of 1866 is also the result of their collaboration. The next year the Gardens were officially declared to be separate from the Palace Grounds and recognized as an independent Governmental scientific institution.

Too short was the term of office of TEYSMANN's next assistant, S. KURZ, who as a soldier of German birth under the name of J. AMANN, arrived in Java (1857). Military duties made him go to Banka (1857-'58) and Celebes (1859) but he was stationed in the Gardens before 1860. His findings in Banka are embodied in a list of 166 vascular cryptogams (32), (under the pen-name J. AMANN), a general study of the vegetation, ecologically and phytogeographically, an enumeration of 959 species, completed by a list of the vernacular plant names by TEYSMANN, and a number of new descriptions by himself (1864).

In 1864, he accepted a post in the Calcutta Gardens but retained a lively interest in the Malaysian flora and regularly discussed problems connected with our region and the Indian flora. KURZ, in spite of his somewhat hurried decisions, was a versatile botanist and talented phytographer; he had a particular flair in defining the plant communities composing a vegetation. Being appointed Curator at Calcutta (1865), he published a long series of large and small articles (e.g. a study he had made at Buitenzorg: the earliest paper (33) on the growth rate of bamboo), on systematics and phytogeography.

His position at Calcutta offered him the opportunity of comparing many Malaysian species with authentic Indian materials (34) and this resulted in

changes in nomenclature or other rectifications which sometimes caused spirited debate in the scientific press. In his articles much critical attention was paid to Sumatran species, previously described by MIQUEL. I mention studies of *Lemnaceae* (35), *Pandanaceae* (36), *Palms* (37), the *Report on the vegetation of the Andaman Islands* (1868 and 1870), his three *Contributions towards a knowledge of the Burmese Flora* (38), the *Preliminary report on the forests . . . of Pegu* (1873-'76, also given as 1875), *Sketch of the vegetation of the Nicobar Islands* (1876), and the *Forest Flora of British Burma* (2 vols, 1877). These numerous works, important to the Malaysian flora not only because several species common to both our and his region, new described or already known, are treated, but also because they are excellent comprehensive surveys of the vegetation in relation to climate, soil, and geophysics of the border areas of Malaysia, were accomplished in a surprisingly short time; KURZ died, in 1878, only 44 years old.

*References:* (1) TREUB, J. E. Teysmann in Teysmannia 1 (1890) 1, also in *Geschied. van 's Lands Plantentuin* (1889) and *Gedenckboek van 's Lands Plantentuin* (1892); SIRKS, *Indisch Natuuronderzoek* (1915) *passim*; VAN SLOOTEN, Teysmann herdacht in *Nat. Tijds. Ned. Ind.* 41 (1931) 27. (2) TEYSMANN, *Nederl. Mij Aanm. Tuinbouw* (1853) 58-64. (3) *Nat. Tijds. Ned. Ind.* 31 (1870) 44. (4) *Ned. Kruidk. Arch.* 2 (1850) 191-201. (5) *Nat. Tijds. Ned. Ind.* 1 (1850) 109-114 and *Ned. Kruidk. Arch.* 2 (1850) 172-190. (6) TEYSMANN, *Widjojo Koesoemo in Nat. Tijds. Ned. Ind.* 9 (1855) 349-356. (7) TREUB, *Inleiding op den Catalogus der Bibliotheek van 's Lands Plantentuin* (1887). (8) *Verh. Bat. Gen. K. & W.* 17 (1838) 139-158, also 'Postscriptum' (1839) 1-4, and *Tijds. Nat. Gesch. & Phys.* 5 (1838-1839) 230-232, *Alg. Konst- & Letterb.* (1842), and *Flora* 30 (1847) 463-469. (9) *Tijds. Nat. Gesch. & Phys.* 5 (1838-1839) 253-271, *ibid.* 9 (1842) 115-180. (10) *Beibl. Flora* 25 (1842) 57-114. (11) *ibid.* p. 1-56. (12) *Tijds. Nat. Gesch. & Phys.* 10 (1843) 115-150. (13) *ibid.* 11 (1844) 49-111. (14) *ibid.* 11 (1844) 178-208. (15) *ibid.* 12 (1845) 77-139. (16) *Nat. & Gen. Arch. Ned. Ind.* 3 (1846) 185-194. (17) *Hook. J. Bot.* 7 (1835) 321-326. (18) *Flora* 38 (1855) 577-579. (19) *Pugillus I in Nat. Tijds. Neerl. Ind.* 10 (1856) 1-253, and *Pugillus II in Acta Soc. Scient. Indo-Neerl.* 1 (1856) 1-54. (20) *Flora* 40 (1857) 529-535. (21) *ibid.* p. 97-106 (22) HASSKARL, *Hortus Bogoriensis descriptus* (1858), *Pars II in Bonplandia* 7 (1859) 170-183, 254-274, *ibid.* 8 (1860) 90-100. (23) *Tijds. Nat. Gesch. & Phys.* 11 (1844) 209-288. (24) HASSKARL, *Horti malabarici clavis nova in Flora* 44 (1861) *passim*, 'Nachträge' in *ibid.* 45 (1862) *passim*; *Clavis locupletissima in Abh. K. Leop.-Car.* 34 (1867) 1-134. (25) HASSKARL, *Neuer Schlüssel in Abh. Naturf. Ges. Halle* 9 (1866) 145-389. (26) *cf.* BOERLAGE in *Teymannia* 4 (1894). (27) *Hasskarl, Commelinaceae indicæ* (1870). (28) *Nat. Tijds. Ned. Ind.* 1 (1851) 425-430, *ibid.* 2 (1851) 651, and *ibid.* 12 (1856) 277-281. (29) *ibid.* 25 (1863) 289-294. (30) *ibid.* 29 (1867) 231-240. (31) *ibid.* 3-29 (1852-1867) *passim*. (32) *ibid.* 23 (1861) 399-412, and

*ibid.* 27 (1864) 142-258. (33) *Indian Forester* 1 (1876) 220-269. (34) *ibid.* 28 (1865) 164-168. (35) *J. Linn. Soc. Lond.* 9 (1867) 264. (36) *Ann. Mus. Lugd. Bat.* 2 (1865) 52 and *J. As. Soc. Beng.* 38 (1869) 145. (37) *ibid.* 43 (1874) 192. (38) KURZ, *Contributions I-III in ibid.* 43 (1874) 39; 44 (1875) 128; 46 (1877) 49.

#### 54. Zollinger

An extremely sharp-sighted observer was the professional plant collector H. ZOLLINGER. He holds, both by his life and work, a somewhat isolated position. A SWISS student of A.-P. DE CANDOLLE's, he went on the proposal of his teacher to Java (Dec. 1841) with the purpose of exploring its flora. The enterprise needed a financial basis, and it was decided that ZOLLINGER would compose sets of dried specimens which were to be forwarded to A. MORITZI, professor of Botany at Solothurn.

From 1842 till 1847, ZOLLINGER travelled tirelessly, climbing a dozen Javan mountains (1) and shifting his research more and more to East Java, where he did most of his collecting. In 1845 he travelled in S. Sumatra (2), in the next year in Bali (3), and Lombok (4), in 1847 in S. Celebes; finally in Sumbawa (5). He found it hard to cover his expenses by the revenue from the sale of duplicates. TEYSMANN's intermediary procured him a temporary Government allowance for collecting on behalf of the Buitenzorg Gardens.

A failing health, and a disappointment in connection with a Government post, made him return to Switzerland (1848). In 1855, he decided to leave again for Java and settle there as a coconut planter. He found time, however, to study *Euphorbiaceae* in the Buitenzorg Herbarium (6). In 1858, he went to Madura on a botanical trip (7), and he made in that year some geographical and geological observations in Bali. He died in 1859 in East Java, 37 years old.

ZOLLINGER had not only a lively interest in but also a good grip on many fields of natural history. He was a considerable collector of, and author on, terrestrial and aquatic fresh water molluscs of the Sunda Islands; his observations on volcanism and geology in general drew attention, and led him, together with his studies on the vegetation to a conclusive view regarding the demarcation of the Malaysian flora. In 1857, he coined the term 'Flora Malesiana', and pointed out how its boundaries had to be drawn; his limits have been confirmed and, on the whole, are now expressed in the design of the present *Flora Malesiana* (8).

It had been arranged that MORITZI should name and distribute ZOLLINGER's plants, and in 1844 a first consignment reached Europe. ZOLLINGER's industry is demonstrated by the fact that it consisted of more than a thousand species and that the total amounted to 20,000 specimens. It is understandable, that not all specimens were found to be well prepared. On the other hand, ZOLLINGER is the collector of many very rare species in East Java, some of which waited rediscovery for more than half a century.



Herbarium of the Royal Botanic Gardens at Buitenzorg

MORITZI published a *Systematisches Verzeichniss* (1845–1846); it deals with 5 of ZOLLINGER's consignments, collected in 1841–1844. ZOLLINGER learnt quickly to describe his plants on the moment of collecting and, being a man of distinct opinions once he had acquired the knowledge enabling him to judge, he gradually preferred to take an active part in the description of his finds. He published e.g. *Observationes phytographicae* (9), to which a supplement appeared in 1857 (*novae*, 9).

Although the two scientists, one in Europe the other in Java, by no means always agreed as to the correct interpretation of the specimens, MORITZI seems to have appreciated ZOLLINGER's contributions, this at least explains why they decided to write jointly a 'Flora Malayana' (1848); MORITZI's death (1850) prevented a further development of the plan.

To ZOLLINGER's first period in Java belong also a paper on *Rafflesia patma* (10), and a *Florae Javæ species* (11).

MORITZI's *Systematisches Verzeichniss* had not been drafted after the entire satisfaction of botanists. When ZOLLINGER was back in Switzerland, he was urged to supply fresh, or more extensive, data to many species which were thought to have been too summarily described by MORITZI, and to publish on his more recent explorations. This resulted, with the help of some colleagues, in a second *Systematisches Verzeichniss*, of which appeared 2 fascicles dealing with systematics and phytography (1854–1855) and a third (1855), which treated the plant physiognomy of the East Indies generally.

The phytographical papers of his second stay I have mentioned (5, 9); some extensive manuscripts, one a 'Pflanzenbeschreibung' and the other a 'Clavis Herbarii Amboinensis' rest in the Herbarium at Buitenzorg.

References: (1) Tijd. Neêrl. Ind. 6 (1843) 141, 347, also Besteigung Tambora auf Sumbawa (1855). (2) Tijdschr. Ned. Ind. 9 (1846). (3) *ibid.*

7 (1844). (4) *ibid.* 9 (1846). (5) Verh. Bat. Gen. K. & W. 23 (1850). (6) ZOLLINGER, Rottlera-Arten . . . zu Buitenzorg in *Linnaea* 28 (1856). (7) Nat. Tijd. Ned. Ind. 17 (1858–1859) 243. (8) ZOLLINGER, Begrip en omvang eener Flora Malesiana in *ibid.* 13 (1857) 293–322, also De Indische Archipel in Mitt. J. Peithes Geogr. Anst. v. Petermann (1858). (9) in Nat. & Gen. Arch. Ned. Ind. 1–3 (1844–1846), also Nat. Tijd. Ned. Ind. 14 (1857) 8. (10) Nat. & Gen. Arch. Ned. Ind. 2 (1845) 353. (11) *ibid.* 4 (1847) 24, 141.

#### 55. Scheffer

R. H. C. C. SCHEFFER, a student of MIQUEL's, having written a doctor's thesis on Malaysian *Myrsinaceae* (1), arrived in 1868 at Buitenzorg and was appointed as Director of the Gardens.

SCHEFFER tried to make the Gardens into the acknowledged centre for agricultural and horticultural research, also in respect to education in these fields, and devoted much of his time to these purposes. A good draughtsman, C. LANG, was added to the personnel; in 1876 the first volume of 'Annales du Jardin Botanique de Buitenzorg' (*cf.* §79) appeared. This (and the second volume of 1885) has the highly satisfactory series of 'heliogravures' which he made of the palms described by SCHEFFER. Two years before, in 1874, the new-housed and rearranged 'Museum and Herbarium voor Systematische Botanie' had been opened to the public, on the site where it has remained till the present, although internal reconstruction and external additions had to follow in the course of time (Library or 'Bibliotheca' in 1897).

SCHEFFER's main phytographical work may be summarized as follows. *Observationes phytographicae* appeared in 3 instalments (2). In 1869 an essay on *Diplanthera* (3), was followed by studies on some palms of the group *Arecineae* (4); in 1874 a survey of botanical papers in foreign periodicals as far as relating to the botany of the Archipelago entitled

*Bijdragen uit het Buitenland tot de kennis der Flora van den Indischen Archipel* (5) appeared and in 1876 an *Énumération des plantes de la Nouvelle Guinée* based on TEYSMANN's collections (6).

It would be an underestimation of SCHEFFER's achievements if his work were only judged by his comparatively few, though careful and sound, descriptive studies. His indirect influence on phytophraphical developments has been considerable.

SCHEFFER was an industrious man. Less than two years of collaboration with TEYSMANN was all his practical training though he made after that some trips in West Java (7) in company of the 'Inspector honorary' (cf. § 53). Much of his time was occupied in organizing the agricultural education of the native population and broadening the economic contacts of the Buitenzorg Gardens. By encouraging internationally the interests in Malaysian botany (BECCARI), by his care of the Herbarium and Library, and by his founding of the 'Annales' the Gardens came to be more widely appreciated and more and more drew the attention of botanists.

Prior to SCHEFFER's term of office the Botanic Gardens at Buitenzorg were largely considered to be, in the first place an institution from where valuable materials for phytophraphy, or botany in general, might be had. In 1880, at SCHEFFER's death, however, the Gardens were to be seen as a centre for exchange, both as regards specimens of plants and of scientific views. When TREUB came to succeed him, he found the ground well-tilled and ready to respond to his endeavour; TREUB's excellent direction had striking results, also in respect to phytophraphy, but so much progress was possible only because SCHEFFER had planned so well.

*References:* (1) SCHEFFER, *De Myrsinaceis archipelagii indici* (1867). (2) *Nat. Tijds. Ned. Ind.* 31 (1870) 1-23, 338-375; *ibid.* 32 (1873) 387-427. (3) *ibid.* 31 (1870) 332-337. (4) *ibid.* 32 (1873) 149-193. (5) *ibid.* 34 (1874) 33-111. (6) *Ann. Jard. Bot. Buit.* 1 (1876) 1-60, 178-181. (7) *Nat. Tijds. Ned. Ind.* 32 (1873) 207-233.

##### 56. *Philippine phytophraphy; Blanco's 'Flora de Filipinas', Fernandez-Villar; Cuming*

In the Philippines, botany had been, and largely remained throughout the 19th century, in the hands of missionary priests. In 1837 appeared MANUEL BLANCO's *Flora de Filipinas*, followed by a second edition in 1845 and a third, in several volumes (4 vols. + 2 vols Atlas 1877-'83), containing also a first publication of some century old manuscripts of fellow priests (Fathers I. MERCADO and A. LLANOS). To the fourth volume of this 3rd edition was added the *Novissima Appendix* by A. NAVES and C. FERNANDEZ-VILLAR, the editors of the work. In this book the phytophraphy of the lowland flora received most attention. MERRILL, undeniably the best judge of BLANCO's work, found that of 1136 species and varieties only 9 were wholly doubtful as regards their identity, an additional 40 could be referred to the genus, the remainder being reduced to a good binomial 'in the entire absence' of any specimens left by BLANCO.

The *Flora de Filipinas* should be used in conjunction with MERRILL's *Species Blancoanae* (1918), a thorough and critical study made most instructive by the distribution of illustrative duplicate specimens to the larger botanical institutes of the world, and which also deals with LLANOS's mainly interpretative *Fragmentos* (1851) and *Nuevo Apéndice* (1856).

A new botanical garden, laid out at Manila in 1858 (degenerated in 1898 into a city park), never held a place comparable to that of Buitenzorg or of Singapore.

Between 1836 and 1840, H. CUMING assembled a really important Philippine herbarium consisting of considerably more than 2000 numbers. These valuable materials hardly attracted the attention they deserved but, nevertheless, formed the base of the few contributions to Philippine phytophraphy which appeared in fifty years. To be noted are S. VIDAL Y SOLER's *Phanerogamae Cumingianae* (1) and N. TURCZANINOW's earlier series of articles in the periodical of the Moscow naturalists (2). Some of CUMING's specimens were mislabelled and so assigned to wrong regions.

*References:* (1) VIDAL, *Phanerogamae Cumingianae Philippinarum* (1885), also *Revision de plantas vasculares Filipinas* (1886). (2) *Bull. Soc. Nat. Moscou* 19<sup>2</sup> (1846) 489-496, 497-510; *ibid.* 20<sup>1</sup> (1847) 148-174; *ibid.* 21<sup>1</sup> (1848) 250-262, 570-591; *ibid.* 24<sup>1</sup> (1851) 166-214; *ibid.* 25<sup>2</sup> (1852) 310-325; *ibid.* 27<sup>2</sup> (1854) 271bis-372; *ibid.* 31<sup>1</sup> (1858) 185-250, 379-476; *ibid.* 36<sup>2</sup> (1863) 193-227; *ibid.* 36<sup>2</sup> (1863) 328-365; *ibid.* 36<sup>1</sup> (1863) 545-615.

##### 57. *West Malaysia; Jack*

In West Malaysia, scientists in the suite of T. S. RAFFLES promoted phytophraphy (cf. HORSFIELD § 40). In 1818, W. JACK, a Scotsman, followed his employer from Calcutta to Penang where he did pioneer work and reported his results to his friend N. WALLICH, Superintendent of Calcutta Gardens. After a stay of several months at Penang and Singapore, the party went to Bencoolen. J. ARNOLD also went with them but died some months after arrival (cf. § 40). Here the flora had been little touched. CH. MILLER (1771), CH. CAMPBELL (1800), W. ROXBURGH (1803), B. HEYNE (1812) had but incidentally collected and described. JACK worked here during four months, to interrupt his research for a voyage to Calcutta, and, returning in 1820, visited some islands off the Sumatran coast. Seeking recovery from his mortal illness he paid a short visit to Java but died in 1822 off Penang. JACK was a particularly inquisitive and able phytophrapher as is convincingly proved by his papers on *Cyrtandraceae* (1), *Melastoma* (2), and other groups appearing in 1823 (3). His collections (partly) and some unpublished manuscripts perished in the fire of the 'Fame' when being dispatched to England; his printed articles *Descriptions of Malayan plants* were nearly forgotten. They appeared in a rare journal issued by the Sumatran Mission Press ('Malayan Miscellanies', 1820-'22) and, though W. J. HOOKER and GRIFFITH had them reprinted





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(4), many of JACK's names have been overlooked. Nevertheless, JACK left his mark on Malaysian phytography and will be remembered to have made a first reconnaissance of the SW. Sumatran flora including to some extent that of the interior and the highlands (5).

*References:* (1) Trans. Linn. Soc. Lond. 14 (1823) 23-45. (2) *ibid.* 14 (1823) 1-22. (3) *ibid.* 14 (1823) 114-130. (4) HOOKER, Bot. Misc. 1 (1830) 273-290, 2 (1831) 60-89, 219-224, 253-272. New repr. in Calc. J. Nat. Hist. 4 (1843) 1-62, 159-231, 305-374; also in Misc. Pap. Indo-China & Ind. Arch. II, 2 (1887) 169-228, 24 246-295. (5) J. Roy. As. Soc. Str. Br. 73 (1916) 147-268.

#### 58. The Malay Peninsula

Botany in the Malay Peninsula, in these years, benefitted from WALLICH's collections at Penang (1822) enriched by those of G. PORTER, W. JACK, and G. FINLAYSON; H. CUMING (§ 56), on his return voyage to Europe, explored Mount Ophir and collected there. W. GRIFFITH, besides searching enormous tracts in British India, made the largest collections in the Malay Peninsula so far obtained (1841-42, 1844); his manuscript notes and studies in Malayan plants have been gradually published among the *Posthumous Papers* by J. MCCLELLAND (4 vols, 1847-1854). His writings abound in clever suggestions, new data, and valuable observations. When writing the Flora of British India (in which the flora of the Malay Peninsula was also considered), HOOKER made use of GRIFFITH's notes.

The Malayan collections of GRIFFITH, as to size and importance, have in this period only been surpassed by A. C. MAINGAY's herbarium, secured in 1862-'69, which is exceedingly rich in Singapore and Penang specimens.

The period is characterized in the Malay Peninsula by the assembling of these (and some other) herbaria; in publications the Peninsula was only referred to incidentally, and very few papers appeared solely dealing with the plants of this region.

#### 59. India; Wallich and contemporaries; Flora Indica

In India, as we have seen (§ 42), the manuscripts of ROXBURGH had been entrusted to CAREY and

N. WALLICH, the adopted name of the Dane N. WOLFF. From 1815, he was Superintendent of Calcutta Botanic Gardens and, when returning to Europe in 1828, he took with him a large Herbarium of 8000 species, including the specimens secured at Singapore and Penang by his helpers W. JACK and G. PORTER. His chief work is the magnificent 3-volumed *Plantae Asiaticae Rariores* (1830-1832) consisting of 300 beautifully executed plates, which was preceded by part of his *A numerical list of the dried specimens of plants in the East India Company's Museum etc.* (1828-'49). This 'WALLICH's Catalogue' was a mimeographed list issued in a limited number and accompanying the consignments of Indian specimens presented to various botanical institutions. It contained many new names (proposed in collaboration with BENTHAM and others) without descriptions.

This resulted in much confusion. In the 19th century, botanists were generally inclined to treat 'WALLICH's Catalogue' as a valid publication in so far as new species were concerned. In the works of HOOKER, DON, DE CANDOLLE and others many of WALLICH's are adopted and furnished with a description. On the other hand, phytographers who had WALLICH's specimens not at their disposal, rejected or neglected WALLICH's names, which was in the 20th century confirmed by the Rules of International Nomenclature (1905). In matters of priority, WALLICH's Catalogue names may now only be considered from the moment that they appeared in print interpreted and described by a later author.

The Madras botanist R. WIGHT, a man of 'remarkable sagacity and boundless energy' published an *Icones Plantarum* (7 vols, 1840-'56) which figured and described more than 2000 Indian plants, a *Spicilegium Nilghirensae* (2 vols, 200 coloured plates) and together with G. A. WALKER-ARNOTT, professor of Botany at Glasgow, a *Prodromus Florae Peninsulae Indiae Orientalis* (1834). This work is written in a lively style, full of interesting observations, and it is greatly to be deplored that it was never completed. WIGHT wrote two volumes *Illustrations of Indian Botany* (1841-1850), intended to portray the plants of the *Prodromus*.

A Forestry Service in India had nominally existed since many years but increased its efficiency, and



its members produced considerable phytographical works in the second half of the century. I confine myself to mentioning Colonel BEDDOME's *Ferns of Southern India* (2 vols, 1863, 1865-'70), and *Flora Sylvatica of the Madras Presidency* (1869-'73), D. BRANDIS and J. L. STEWART's *Forest Flora of NW. and Central India* (1874), and J. S. GAMBLE's excellent work on *Bambusaceae*; the latter was editor of 'The Indian Forester', an important monthly (1876-). GAMBLE based his study in *Bambusaceae* on Colonel W. MUNRO's monograph of 1866 (1).

A forerunner of the *Flora of British India* (see next paragraph) appeared in 1855: the single volume of a *Flora Indica* by J. D. HOOKER and TH. THOMSON. The introductory essay is one of the most valuable studies in taxonomic botany ever written (cf. Chapter 3, of this volume). For further details I must refer to e.g. KING's (§ 87) studies on the history of Indian botany (2) and I. H. BURKILL's (§ 90) MS. treating 150 years of Indian botany (now being written).

*References:* (1) Trans. Linn. Soc. Lond. 26 (1866) 1-157. (2) Gard. Chron. 26 (1899) 252-254, and J. Bot. 37 (1899) 454.

#### 60. Resident amateur botanists in Malaysia

Phytography in this period in Malaysia was also furthered by another group of workers, the resident amateur botanists. The botanical work and interests of non-professionals in Malaysia (RHEDE, RUMPHIUS) made there the first solid base of all future phytography, in contradistinction to the course of history in Europe where as a rule the foundations were laid by persons to whom knowledge of plants was an asset to their daily occupation (herbalists). After professional scientists had come to the fore—only when political and economic development after more than a century of European administration had created favourable conditions—the plant-loving 'lay-community' continued to take part in the progress of botany in a most gratifying manner.

J. B. SPANOGHE, born at Madras from Belgian parentage, a modest and little noticed, physically weak man, withheld his good *Prodromus Florae Timorensis* from publication when J. DECAISNE's *Timor Flora* (§ 105) appeared (1835). His considerable collections of plants, manuscripts, and drawings (now partly preserved at Leyden) were publicly sold after his death. D. F. L. VON SCHLECHTENDAL published this *Prodromus* in 1841 in 'Linnaea'; SPANOGHE's other publications are a sketch of the *Flora of Timor* (completed by a Catalogue of some 600 Timor plants, and a report on the Upas tree in collaboration with W. J. HOOKER (1)).

C. F. E. PRAETORIUS, of German birth, President of Palembang, S. Sumatra (1829-'34), wrote an account of timbers in BLUME's short-lived 'De Indische Bij' (1843). His data will have served W. L. DE STURLER in his descriptive study of East Indian timbers (2). He wrote a book on agriculture, which relied too much on earlier Indian literature (3). An inventory of Riouw and East Sumatra was made by G. F. DE BRUYN KOPS (4).

The interest in plants as a hobby is often accompanied by an interest in their possible economic promise and this leads occasionally to the advancement of phytophraphy. Among many, I mention surgeon TH. OXLEY, who wrote of his quest for gutta-percha producing trees in Penang, Singapore, and Sumatra (5), and J. MOTLEY's collections and letters on the same and similar subjects from Borneo (6). G. J. FILET, Dutch Army surgeon, wrote a dictionary, a *Plantkundig Woordenboek van Nederlandsch-Indië* (1876, improved 2nd ed. 1888), based on a rather uncritical list (7) of native names (1859). When specializing in the study of vernacular plant names he made, in 1854, the *Tweede Catalogus*, a second Catalogue of the plants cultivated in the botanical garden (better: pharmaceutical garden) of the Military Hospital at Weltevreden (Batavia). He listed 504 species. His work relied largely on literature studies, and he was not always fortunate in his choice. J. H. W. CORDES, a forester in Java and Sumatra, had an interest in phytophraphy (9). His work on the teak forests of Java became widely known (10).

Towards the end of this period, the first papers on microscopic *Algae* appeared (11) by J. G. BERNELOT MOENS, phytochemist and quinologist, and by J. B. B. NAGELVOORT (12), a military apothecary who wrote also on *Rafflesia* (13).

*References:* (1) Hook. Comp. Bot. Mag. 1 (1836) 308-317. (2) DE STURLER, Beschrijving der Houtsoorten in Ned. Oost-Indië (1866). (3) DE STURLER, Handboek voor de Landbouw in Ned. Oost-Indië (1868). (4) Tijd. Ind. Taal-, Land- Volk. 1 (1859) 272-317. (5) cf. New Edinb. Philos. J. (1848). (6) Hook. J. Bot. Kew Gard. Misc. 9 (1857) 148-153. (7) Nat. Tijd. Ned. Ind. 19 (1859) 1-280. (8) *ibid.* 7 (1854) 19-36. (9) *ibid.* 29 (1867) 130-135. (10) CORDES, De djatibosschen op Java (1881). (11) Geneesk. Tijd. Ned. Ind. 4 (1872) 409. (12) Nat. Tijd. Ned. Ind. 35 (1875) 268-269. (13) *ibid.* 35 (1875) 171-180.

#### 61. The 'Natuurkundige Vereeniging'; periodicals

Highly conducive to the promotion of phytophraphy was the founding of the 'Natuurkundige Vereeniging in Nederlandsch-Indië' (1850, since 1860 'Royal'). This Society was liberally supported by the 'Bataviaasch Genootschap', and, intending to further the natural sciences, published the 'Natuurkundig Tijdschrift voor Nederlandsch-Indië'.

The title was modified to 'Natuurwetenschappelijk Tijdschrift, &c.' (vol. 101, 1941), and in Jan. 1947 changed to 'Chronica Naturae' (vol. 103).

The 'Natuurkundig Tijdschrift' had been preceded by the 'Natuur- en Geneeskundig Archief voor Ned.-Indië' (1844-'48). Another issue of the Society was the 'Acta Societatis Scientiarum Indo-Neerlandicae' (Verhandelingen der Kon. Nat. Vereeniging in Ned. Indië, 8 vols, 1856-'60). Phytographical articles are also found in 'Tijdschrift voor Neerland's Indië' (1838-'48; after that year edited in the Netherlands till 1902, when it was incorporated in 'Indische Gids'). Finally is to be not-

ed 'Tijdschrift voor Nijverheid in Nederlandsch Indië' (1854-1917; 'en Landbouw' was added to

the title with volume 7). To the 'Annales' I have referred in § 55 (cf. also § 37).

## MALAYSIAN PHYTOGRAPHY AFTER 1880

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### 62. *The state of phytography at the end of the 19th century*

Towards the close of the 19th century, the surge of general comprehensive standard works on taxonomic botany lost vigour. Several of the largest, issued over many years, neared completion and new ones, though here and there begun, were slow in starting and tardily continued, rather in the manner of serials written by a large number of experts. The time for systematic monographs, one author dealing with the whole plant system with regard for detail, was past; the vast collections, the endless stream of literature, the continually growing fund of data on all aspects of taxonomy demanded on one hand specialization and, on the other hand, team work if studies or detailed books of a general nature were desired. This implied a flood of usually small, scattered articles on incidentally chosen limited groups and a phytography of most diversified aspects and merits. To be kept informed of the current scientific developments required a measure of time and energy on the part of the phytographer, the librarian, and the bibliographer as never before, and this scattered and varied phytography has made any general survey of necessity very incomplete; a satisfactory approach to the literature is only possible by means of voluminous bibliographical lists.

Phytography, in this period, sometimes followed the Linnean precepts or, less artificially, aimed at a brief description which laid sufficient stress upon specific characteristics and natural affinities (roughly: the English school). Sometimes, also, it was intended to draw a plant portrait which, preferably, ought to be brief but should be sufficiently close to delimit the plant species as such clearly, even if not contrasted against allies (roughly: the French school). Thirdly, phytographical analysis became long drawn and meticulously detailed on purpose. The latter method seems to indicate that the describer was not yet prepared to accentuate natural affinities (many species still being unknown) but wished to provide future students with as many data as possible; of course, by typographical means differential characters might be tentatively proposed (roughly: the German school). In

addition, distinction must be made between *specimen* description (unavoidable as often as 'only the type is known') and *species* description, and there are many variations on these methods and much hybridizing.

The three present centres of phytography in Malaysia did not develop simultaneously. Buitenzorg, under TREUB, had approached the best years of its history when, at Manila, under MERRILL in the opening years of the century, phytography only began its career; nearly simultaneously, at Singapore, under RIDLEY, the phytography of the Malay Peninsula found a definite home. It seems justified to sketch an outline of the history of plant description in the Netherlands East Indies during TREUB's term of office (1880-1909), and to postpone the survey of events in the Philippines and the Peninsula till the following chapter (§§ 80-94).

### 63. *General handbooks*

In the preceding chapter (§ 45), it has been demonstrated that BENTHAM and HOOKER's *Genera Plantarum* was close to completion when M. TREUB arrived in Java. This revision of genera was of eminent importance to Malaysia especially as regards the Netherlands Indies because the authors had examined considerable Malaysian collections. H. E. BAILLON's *Histoire des Plantes* (13 vols, 1867-1895) had the phytographical advantage of being illustrated, as was his *Dictionnaire de Botanique* (1876-'92). In 1889, (H. G.) A. ENGLER and K. PRANTL began their *Die natürlichen Pflanzenfamilien*, a serial work and treatise of the world's families and genera that, with the help of many collaborators, achieved completion in 1909; this was supplemented by *Nachträge* (3 vols, 1897, 1900, 1915). A second edition began to appear in 1924. The first parts of *Das Pflanzenreich*, a sequence of monographs edited by ENGLER, after the example of the *Suites au Prodrôme* (§ 45) appeared in 1900; since 1905 this was continued under the editorship of L. DIELS. These great German works are a chief source of information to all taxonomic study. As regards phytography, the several fascicles differ much in quality and thoroughness; though some revisions rank among the best ever written, others are unsat-



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isfactory. ENGLER's organizational work and editorship was very effective; in rapid succession appeared a sequence of monographs which surpassed all that had been done before.

The *Genera Siphonogamarum* by C. G. DE DALLA TORRE and H. HARMS (1900-'07) provided an index to all generic names, arranged in conformity with the Englerian system, but with reference to the other standard works and, in the latter part, in accordance with the decisions of the International Botanical Congress at Vienna in 1905.

O. KUNTZE, world-wide traveller, wrote his taxonomically and historically important *Revisio generum plantarum* (4 vols, 1891-1898). G. KARSTEN and H. SCHENCK edited *Vegetationsbilder* (1903-1940), general descriptions and photographs of plant communities including some of Malaysia.

In England, the composition of a work enumerating all specific names with citation of literature was entrusted to B. D. JACKSON, author of *e.g.* the *Guide to the Literature of Botany*, in 1881. In collaboration with J. D. HOOKER two volumes appeared in 1895; they contained 'an enumeration of the genera and species of flowering plants, from the time of LINNAEUS to the year 1885 inclusive'. The necessary funds for this enormous work had been provided by a legacy from CH. R. DARWIN. *Index Kewensis* was recognized as an indispensable list of reference and it is now admitted that the study of systematic botany is impossible without recourse to this invaluable compilation. Ten supplements, after the first volumes, enumerated the species new described between 1885 and 1940. The 10th supplement summarizes also all plant pictures if accompanying new species made in the period 1936-1940 and so is in part a continuation of *Index Londinensis* (6 vols, 1929-'31), the list of botanical plates made under supervision of O. STAPF, which succeeded PRITZEL's earlier work. The two supplementary volumes by W. C. WORSDELL (1941) contained the list of pictures published in the years 1921-'35, and brought the issue to a close.

TH. A. DURAND, Professor of Botany at Brussels, compiled an *Index Generum Phanerogamarum* (1893), in which the systematic arrangement by BENTHAM & HOOKER was followed. The main French work of this class in later years is A. LEMÉE's *Dictionnaire descriptif et synonymique des*

*genres de plantes phanérogames* (8 vols, 1929-'43, vol. 7 containing keys to the families, vol 8a and 8b to the genera); an astonishing achievement for one single botanist and, as it contains generic diagnoses, in some respects a successful supplement to the above mentioned handbooks though not always critical and reliable in its details.

#### 64. Chief phytophraphical works in neighbouring regions; Bentham

This summary of comprehensive handbooks narrows down to the general phytophraphical works dealing with the flora of the regions bordering on Malaysia, and so of direct bearing on the phytophraphy of our region.

J. D. HOOKER began in 1872 his *Flora of British India* which, assisted by various botanists, he completed in 1897 (7 vols). Its lasting importance as a foundation to further study and a source of reference to Malaysian taxonomy, needs no comment. HOOKER also completed H. TRIMEN's *A Handbook to the Flora of Ceylon*. TRIMEN, Curator of the Peradenia Botanic Garden (1879-'96) had published 3 volumes (1893-'95) but a failing health compelled him to desist from continuing his very critical reliable work. J. D. HOOKER wrote and published volume 4 and 5 (1898, 1900). In 1931 appeared A. H. G. ALSTON's supplementary volume in which the necessary nomenclatural changes were made and the latest data added. The value of TRIMEN's concise phytophraphical work is increased by his observations of plant ecology and biology. The *Medicinal plants* were treated in R. BENTLEY and H. TRIMEN's book (4 vols, 1880) and economic botany of the Indian peninsula received a firm basis in WATT's *Dictionary of economic products of India* (1889-'93).

The *Flore Forestière de la Cochinchine*, by L. PIERRE, a folio work of 400 beautiful and detailed lithographs of trees accompanied by descriptions, remained incomplete (4 vols, 1879-'99); the author's extensive and remarkably good collections were liberally distributed and enrich many herbaria, often providing conclusive evidence when compared with Malaysian material.

H. LECOMTE's *Flore générale de l'Indo-Chine* was planned in 7 illustrated volumes, and began to ap-

pear in 1907. After the 7th volume had been completed, it was tried to cope with the influx of new specimens in editing supplementary parts. In the 8th, or preliminary volume, concise historical and personal data in relation to the phytography of Indo-China were supplied. It would seem that the writing of this Flora was started when collections were decidedly insufficient and many essential data were still wanting; LECOMTE and his collaborators, however, very often succeeded in composing revisions much helpful to Malaysian phytography.

A general Flora of Siam (Thailand) was not attempted but W. G. CRAIB's *Florae Siamensis Enumeratio* is a good key to its phytography. Although the book 'enumerates' the specific names, it contains many very valuable notes. The work was begun in 1925, and at CRAIB's death (1934) the 3-5th instalments of vol. 2 were edited by the late A. F. G. KERR, assisted by H. R. FLETCHER.

Here belongs a *Flora of Assam* by U. N. & P. C. KANJILAL, A. DAS c.s.; the first volume appeared in 1934, the fifth in 1940, containing the *Gramineae*, was written by N. L. BOR.

The floras of China, Formosa, and the Pacific Islands are so widely different from that of Malaysia that the books, or studies, of those regions have only rarely direct bearing on ours. Much more important is *Flora Australiensis* (7 vols, 1863-1878) written by G. BENTHAM, in part assisted by F. VON MUELLER.

G. BENTHAM has been repeatedly mentioned (§ 48) in this short history and it is necessary to add some additional titles selected from his numerous publications.

His was the execution of the first of the later British colonial Floras (*Flora Hongkongensis*, 1861) and so he drafted the model after which all posterior publications in this field were made. He was a firm believer in the constancy of species but, confronted with the host of persuasive facts collected by DARWIN, and of course unaware of modern experimental taxonomy, had the courage to submit to Darwinism 'with severe pain and disappointment'. Being essentially accurate, precise in his descriptions, and instinctively conscious of the weight of characters taxonomically, he was convinced that a 'typical individual' was only an abstraction as well as a 'typical species'. This complex of inborn convictions and acquired knowledge may have led to his delimitation of species which is, phytographically, strikingly good and, at the same time, sparing in detail. His larger studies (apart from those already mentioned) are his contributions to DE CANDOLLE's *Prodromus* (*Scrophulariaceae*, 1846; *Labiatae*, 1848), his revision of *Leguminosae* (1), and his notes on *Loganiaceae* (2).

F. J. H. (VON) MUELLER, Government Botanist of Victoria (SE. Australia) and, later, Director of the Melbourne Botanical Garden (1857-'73), wrote many articles on Australian botany and several on the flora of New Guinea and the Moluccas. There are dozens of small papers on plants of New Guinea and adjacent islands (3). His chief works are *Fragmenta phytographiae Australiae* (12 vols, 1858-'82), *Descriptive notes on Papuan plants* (9

pts, 1875-'90), and *Iconography of Australian Species of Acacia and cognate genera* (1887-'88). VON MUELLER died in 1896, a German by birth, who worked entirely in agreement with the English school and, on several occasions, materially aided the Buitenzorg Gardens and Malaysian phytography.

F. MANSON BAILEY, Colonial Botanist of Queensland, made a flora of this province (*The Queensland Flora*, 1899-1902, General Index 1905), a handbook often consulted by Malaysian botanists when studying the vegetation of New Guinea or that of the Lesser Sunda Islands. He wrote a series *Contributions to the flora of New Guinea* (4). In 1909 he published his *Comprehensive Catalogue of Queensland Plants*.

On the flora of Christmas Island (S of Java, phytogeographically a part of Malaysia) appeared E. G. BAKER's study in 1900 (5). There are also H. N. RIDLEY's *A day at Christmas Island* (6), *An expedition to Christmas Island* (7), and *Christmas Island Flora* (8).

*References:* (1) HOOK. Journ. Bot. 4 (1842) 323-418; London Journ. Bot. 1 (1842) 318-392, 494-528, *ibid.* 2 (1843) 423-481, 559-673, *ibid.* 3 (1844) 82-112, 195-226, 338-365, *ibid.* 4 (1845) 577-622, *ibid.* 5 (1846) 75-108; in MIQUEL, Pl. Jungh. (1852) 205-270; J. Linn. Soc. 4 (1860) Suppl. 1-134; Trans. Linn. Soc. 27 (1871) 503-591, *ibid.* 30 (1875) 335-664. (2) J. Linn. Soc. Bot. 1 (1857) 52-114. (3) see e.g. Descr. New Papuan Plants in Journ. Bot. 29-31 (1891-1893) *passim*. (4) Queensland Agric. Journ. 6-26 (1898-1911) *passim*. (5) 'Botany' in A monograph of Christmas Island (1900). (6) J. R. As. Soc. Str. Br. 23 (1891) 123-140. (7) *ibid.* 45 (1906) 137-271. (8) *ibid.* 48 (1907) 107-108.

# 65. Treub's scientific work

With these (and other, now unmentioned) general and special studies relating to Malaysian phytography as a background, MELCHIOR TREUB, back in the eighties, built the Gardens at Buitenzorg into a world centre of botanical studies. It will be remembered that TREUB himself published some papers of great interest viz on *Spathodea* (1), on hydrocyanic acid in *Pangium* (2) (1896), on ant plants (3), on *Uncaria* (4), on *Dischidia* (5), and on other biological or physiological subjects. In addition, he investigated and described the re-establishment of the flora of Krakatoa (6) after the eruption (1883), on economic botany, on the development of the Gardens; he was a talented historian (*cf.* his preface to the catalogue of the Buitenzorg Library, 1887, his biography of TEYSMANN (7), BOERLAGE (8), and the short history (9) of the Botanic Gardens (1892).

MELCHIOR TREUB was born in 1851, in Holland and, a gold medallist, assisted SURINGAR from 1874 till 1880. His fellow students were HUGO DE VRIES and M. W. BEIJERINCK. At Leyden, TREUB demonstrated the true nature of Lichens by cultivating *alga* and *fungus* separately (10); research into growing meristems of *Palmae*, *Pandanaceae*, and *Selaginella* established him as a skilful microscopist.

He investigated also the embryology of Orchids (11), *Euphorbiaceae*, *Asclepiadaceae*, and *Urticaceae*.

At Buitenzorg, he continued his cytological work by studies (12) in *Lycopodiaceae*, *Zamia* and *Ceratizamia*, *Loranthaceae*, *Burmanniaceae*, *Avicennia*, *Casuarina* (chalazogamy!), and *Balanophora*; he wrote on the embryology of *Ficus hirta* and *Elatostema*. His studies and publications were not written with an intent to add to phytophagy although they contain here and there some descriptive parts.

*References:* (1) Ann. Jard. Bot. Btzg 8 (1890) 38-46. (2) *ibid.* 13 (1896) 1-87. (3) *ibid.* 3 (1883) 129-159, *ibid.* 7 (1888) 191-212. (4) *ibid.* 3 (1883) 44-75. (5) *ibid.* 3 (1883) 13-36. (6) Tijd. Ned. Ind. 17 (1888) 153; Ann. Jard. Bot. Btzg 7 (1888) 213; Nat. Tijd. Ned. Ind. 48 (1889) 338; Versl. & Med. Kon. Akad. Wet. Amsterdam afd. Nat. III, 5 (1889) 4. (7) *Teysmannia* 1 (1890) 1. (8) Nat. Tijd. Ned. Ind. 60 (1901) 396-412. (9) 's Lands Plantent. te Btzg (1892) 3-58. (10) TREUB, Onderz. natuur der Lichenen (1873). (11) Verh. Kon. Akad. Wet. 19 (1879) 1-50. (12) see Ann. Jard. Bot. Btzg 2-13 (1885-1896) *passim*.

#### 66. Treub's organizatory work

Having held the post of Director during a quarter of a century, TREUB saw his Gardens grow to a complex organization of various institutions connected with all theoretical and practical branches of Malaysian plant science; ultimately, the Gardens were officially recognized as a full Department of the Netherlands Indian Government (Department of Agriculture, 1905). TREUB retired in 1909, to die a year later; with him the Gardens as a whole had passed their zenith.

TREUB used all his talents and resources to strengthen the position of the Gardens, to extend and to intensify their interests. His eminent direction has been repeatedly described. His parting words (1909) were: "Ensuite, j'ai pensé faire acte de patriotisme en engageant autant que possible les naturalistes de tous les pays à venir dans notre colonie hollandaise faire connaissance de la remarquable richesse et de l'exubérance de la flore et de la faune. J'ai cru agir—je tiens à le réitérer—dans la mesure de mes moyens, en l'honneur de ma patrie en facilitant les recherches des nombreux hommes de science qui se sont rendus à Buitenzorg." He made these sentiments to a living reality. To read his words in our present troubled days, fills one with a certain envy though it may be pointed out that this spirit still lives and is expressed in the organization of our present *Flora Malesiana*.

I must confine myself to an account of what made possible the progress of Malaysian phytophagy under his guidance. In particular after the opening of the first Foreigner's Laboratory (1885) and the establishment of the international 'Buitenzorg Fund' (1888), a financial support to visiting scientists, the idea of spending some time in the Gardens became familiar to botanists. The Tjibodas Garden, obtained a Laboratory (1891), and in

that year the Buitenzorg Gardens were increased by the 'Island', which meant another 30 acres lying in the larger river which runs through the Gardens, the Tjiliwong.

These facilities greatly furthered phytophagy while new laboratories or experimental stations also contributed to some extent. TREUB was instrumental in founding the Gutta-percha Station at Tjipetir (1885), the Pharmacological Laboratory (1888), the Phytopathological Laboratory (in the Economic Gardens, 1890), the Tobacco Research Station (1893, at Medan), Coffee Research Station (1896, at Bangelan with P. J. S. CRAMER in 1901), the 2nd Agricultural College (1900), the Indigo Experimental Station (1902), the Tea Experimental Station (1903), the Experimental Station for Rice and other Javan cultures (1905), the Geological Laboratory (1905), the Laboratory for Marine Research (1905), the Museum and Office for Economic Botany (1905), and the Office for Agricultural Analysis (1905).

TREUB remains the glory of the Buitenzorg Gardens. He built their complex organization by masterstrokes, with a deft and elegant touch, by an inimitable perception where, in the change of circumstances, lay advantage for the Gardens, and by an exemplary devotion and loyalty to his task; his work crowned what had been achieved in the past and gave it a new and deeper meaning. He made possible a future progress honourably matching the best results anywhere in the tropics. Malaysian phytophagy owes him a never to be quitted debt.

#### 67. Treub as a promoter of phytophagy; Burck, Jaheri

TREUB, personally, had no intent to work as a systematist and phytophagist, but his are the words: (transl.) "Rightly it may be contended—and it ought to receive full emphasis—that, in the course of time, the upholding of the standard and repute of the Botanic Gardens first of all depends on the standing of the Herbarium" (from an official letter, 1893). This view governed his continuous efforts, during many years, to make the Gardens rank among the leading institutions in the field of Malaysian phytophagy.

TREUB, then, directed his attention to the Herbarium, the natural centre for Malaysian phytophagy as applied in taxonomy. He met with considerable difficulties.

MIQUEL, in charge at Utrecht of the education of students and the author of the first general Flora of Malaysia (§ 48), had hardly left any pupils. He believed his work to be conclusive (this feeling is frequently observed in scientists who have reached the end of fundamental and comprehensive studies) and a conviction of this nature will not attract beginning scholars. MIQUEL even persuaded the Minister that the post of Keeper in the Rijksherbarium at Leyden, after the publication of *Flora Indiae Batavae*, had become superfluous and the position was accordingly discontinued. TREUB, intent on promoting a science which he clearly saw had



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hardly past the first preliminaries, found himself practically with no suitable assistance to be called in from the Netherlands. It became his policy, realized only in the course of time after determined efforts, to have a small permanent Staff in the Herbarium. Temporarily appointed (usually foreign) systematists were to reinforce this Staff and stayed sometimes for several years at Buitenzorg.

When TREUB arrived, the Buitenzorg Herbarium contained slightly over 120,000 specimens. W. BURCK, became subdirector of the Gardens, and simultaneously Head of the Herbarium and Library (1881).

BURCK (born in 1848) was a pupil of SURINGAR's. TREUB was well acquainted with him but collaboration between them did not stay as smooth as might have been expected though BURCK did much to improve the Herbarium. His phytographical studies were in majority prompted by practical problems. The *Dipterocarpaceae* were investigated with a view to their valuable timber and resins (1), *Erythroxylon* on account of cocain (2), *Sapotaceae* (3) in order to discover the best source of gutta-percha (trip into the Padang district, 1883).

BURCK opposed those botanists who thought cross-fertilization all-important and studied the floral biology of e.g. *Rubiaceae* (4), *Connaraceae*, *Leguminosae*, and *Aristolochia* (5) to prove the importance of self-pollination. He left the Herbarium on European leave in 1891, and did not return to the Garden.

One of the best-known collections acquired in those years was that of Mantri JAHARI (Kei Islands, 1888). A collection of quite a different character was initiated by BURCK in 1889, the so-called 'Garden Herbarium'. Many seeds or seedlings secured on expeditions had gradually developed to mature plants in the Botanic Gardens, and the systematical collecting of flowering and fruiting specimens there has resulted in thousands of perfect specimens which added greatly to the value of the original fragments in the General Herbarium by supplying much supplementary data for later descriptions.

A third, much smaller set of specimens, each of the highest value taxonomically, was received as a number of duplicates extracted from KUHLE and

VAN HASSELT, BLUME, and JUNGHUHN's herbaria, preserved in Holland at Leyden and Utrecht, and selected on TREUB's request by J. G. BOERLAGE for transfer to Buitenzorg.

*References:* Ann. Jard. Bot. Btzg 6 (1887) 194-244. (2) *Teysmannia* 1 (1890) 385-398, 449-464, also *Ned. Kruidk. Arch.* 6 (1893). (3) Ann. Jard. Bot. Btzg 5 (1886) 1-85, also *Med. 's Lands Plantent.* 1 (1884). (4) Ann. Jard. Bot. Btzg 3 (1883) 105-118, *ibid.* 4 (1884) 12-88. (5) *Tijd. Nijv. Landb. Ned. Ind.* 28 (1883); Ann. Jard. Bot. Btzg 10 (1891) 75-114; *Nat. Tijd. Ned. Ind.* 49 (1890) 501-544; *Teysmannia* 2 (1891) 129-147.

#### 68. Boerlage and Hochreutiner

BOERLAGE, like BURCK (§ 67) an old acquaintance of TREUB's student days, had investigated (1) the wood anatomy of *Moraceae* (1875). He had accepted employment at the Leyden Rijksherbarium in 1879, though SURINGAR only succeeded in reinstating the post of Keeper (§ 48) or 'Conservator' after a long struggle (1881). He wrote (2) subsequently on Malaysian *Araliaceae* in 1886 and 1887, and on *Achyranthes* (3).

In 1888, he went as a Buitenzorg stipendiate (§ 66) to Java, where he collected, and wrote a paper on *Gramineae*, in the meantime assembling data for a handbook on the genera of the Malaysian flora. Returning to the Netherlands, he published successively his main work *Handleiding tot de kennis der Flora van Nederlandsch-Indië* (5 inst. 1890-1900). His untimely death precluded completion and though its usefulness could not be denied, it followed rather closely its guide: BENTHAM and HOOKER's *Genera Plantarum*. Other articles by BOERLAGE are e.g. on *Erythrina* (4) and an elaboration of Sumatran plants collected on VAN HASSELT's expedition of 1877-1879 (5). He composed numerous contributions to the first edition of the *Encyclopedie van Nederlandsch Indië* (1896).

BOERLAGE stayed at Leyden and was appointed subdirector in 1894. Ignoring several refusals, TREUB persuaded him to come to Buitenzorg. In 1896, he arrived and became subdirector of the Gardens and Head of the Herbarium.

He began a new Catalogue of the Gardens



(1899); only a second instalment appeared posthumously (1900). VAN ROMBURGH's collection of rubber producing plants received his attention and he began work on a Flora of the Buitenzorg Phanerogams. In 1900, he left with J. J. SMITH for Amboina in quest of Rumphian plants; malignant fevers caused his death at Ternate within three months. TREUB wrote: (transl.) "He was one of those who know to utilize their talents as well as possible, and to whom the desire for earnest, thorough and genuine labour is always prevalent."—As a photographer, BOERLAGE's descriptive work is trustworthy and satisfactorily modelled. The famed 'Icones Bogorienses', a series of fine lithographed plates accompanied by descriptions, he had initiated in 1897, being helped by J. J. SMITH and TH. VALETON who wrote in particular in the later volumes, while BOERLAGE himself described many *Annonaceae* in the first volume. The first World War caused its discontinuation after 400 plates, in 4 volumes, had appeared (1914); it was never resumed (§ 79).

BOERLAGE's study in *Gramineae* (6), then, when published in 1890, was intended as a first step towards a Flora of Buitenzorg, the first of a preliminary series of papers introducing a comprehensive Flora of the district. TREUB, confronted with the abundance of the tropical vegetation, no systematist himself, and with few assistants, thought it prudent not to embark on a Flora of the whole of the Netherlands Indies, let alone of Malaysia (cf. § 71).

B. P. G. HOCHREUTINER, a Swiss botanist of the Conservatoire et Jardin Botaniques at Geneva, since long a centre of Malaysian phytophagy, continued, more or less, BOERLAGE's work towards a new Catalogue of the Buitenzorg Gardens. In 1904–1905 appeared 2 instalments (7), composed during his stay at Buitenzorg (1903–1905). In a pamphlet *Plantae Bogorienses exsiccatae* preceding the fascicles of the Catalogue, a number of new species were described; 10 sets of illustrative specimens were distributed among the leading herbaria of the world (1904). In 1910 followed *Descriptiones Plantarum bogoriensium exsiccatarum novarum* (8) but the Catalogue was never continued; in 1908 an Index closed the issue. A famed series is *Plantae Hochreutineranae* (1912–1940); the 5th fascicle of 1940 contains an Index to the preceding parts (9). HOCHREUTINER described (among his numerous publications) in particular *Malvaceae* and *Tiliaceae* but preferably studied the families as occurring throughout the tropics.

*References:* (1) BOERLAGE, Bijdrage tot de kennis der houtanatomie (1875). (2) Ann. Jard. Bot. Btzg 5–6 (1886–1887). (3) Ned. Kruid. Arch. 5<sup>3</sup> (1889) 421–430. (4) Teysmannia 3 (1892) 535–542, 5 (1894) 20–21 (5) in VETH, Midden-Sumatra 4<sup>2</sup> (1884) 49 pp. (6) Ann. Jard. Bot. Btzg 8 (1889). (7) Bull. Inst. Bot. Btzg 19 and 22. (8) Ann. Jard. Bot. Btzg, suppl. 3 (1910) 816–870. (9) Ann. Cons. Jard. Bot. 15/16 (1912) 145–246, Candollea 2 (1925) 317–513, *ibid.* 5 (1934) 175–341, *ibid.* 6 (1936) 399–488, *ibid.* 8 (1940) 47–60.

#### 69. Koorders and the Forest Flora of Java

Since 1872, the Forestry Service had felt the need of a Forest Flora of Java. The increasing facilities for phytophagical research in the Buitenzorg Gardens made the Service decide to offer TREUB the direction of the writing of a Java Forest Flora which was considered to be a fitting introduction to a Java Flora generally (1892). Forest Officer S. H. KOORDERS had been engaged in collecting the forest flora since 1885 and had assembled a vast annotated herbarium (cf. § 73), and since 1890 had begun to elaborate the materials. TREUB accepted and KOORDERS was transferred to the Gardens.

As a result of his own studies, and at the time that this Forest Flora of Java began to appear, KOORDERS wrote in 1892 a *Lijst der Geslachten van de Boomsoorten op Java*, in 1891–1893 *Zakflora of Sleutel voor de geslachten en families der Woudboomen van Java* (1) and, in 1894, a *Plantkundig Woordenboek voor de boomen van Java* (2). These publications demonstrated that he possessed the best field-knowledge of Javan forest trees, and TREUB ruled that KOORDERS should continue in bringing together a Java herbarium with a view to completeness while TH. VALETON (§ 72) described these materials and arranged them taxonomically, aided by KOORDERS's extensive field notes. In the serial *Mededeelingen van 's Lands Plantentuin* (continued as *Mededeelingen van het Departement van Landbouw*), separate volumes began to appear under the title *Bijdragen tot de kennis van de boomsoorten van Java* (*Contributions ad cognitionem etc.*). Between 1894 and 1914, thirteen volumes were issued, together an impressive standard work of which the first eleven were written by VALETON and the final two by J. J. SMITH. Various sections of the work are of the highest phytophagical value. It is now outdated and, of course, nomenclatural changes have become necessary, but the book remains indispensable to all future study of Javan trees. Very few additional species were discovered since its appearance. When, in 1913, the Forest Research Station at Buitenzorg was opened, it could start the ecological and economic study of Javan forest trees relying on taxonomical resources as good as might be found anywhere in the tropics.

*References:* (1) *Zakflora voor Java* (1893), first publ. Nat. Tijd. Ned. Ind. 51 (1891) 361–372, and *ibid.* 52 (1892) 209–328. (2) *Meded. 's Lands Plantent.* 12 (1894), cf. also *Teysmannia* 5 (1894) 4–29, 229–256, 467–478, and *Tijd. Nijv. Landb. Ned. Ind.* 48 (1894) 205–244; also 'Iets over de aanleiding en de resultaten &c.' (1894).

#### 70. Hallier f.

Another local Flora was planned and begun by J. G. HALLIER, a German scientist also calling himself H. G. HALLIER or HALLIER-SCHLEIDEN, a pupil of E. HAECKEL's. In 1893 he came to Buitenzorg and, soon after being appointed as a botanist in the Herbarium, accompanied A. W. NIEUWENHUIS on his Central Borneo Expedition (1893–1894), bringing c. 2500 specimens back. This expedition



was organized by the 'Maatschappij ter bevordering van het Natuurkundig onderzoek van de Nederlandse koloniën' (established in 1890, TREUB being one of the founders), and the 'Indisch Comité' etc., which was the Maatschappij's representative in the East Indies. HALLIER started preparations for a Bornean Flora mainly based on his own and on TEYSMANN's collections. The plans never fully materialized but as a result many articles came from HALLIER's desk (1), among which some of his studies in *Convolvulaceae*, a family which he studied generally and with preference (2).

In 1896 he left Buitenzorg and was appointed Assistant in the Botanical Museum at Hamburg; from 1902-'04, he explored and worked again in East Asia (Pacific, Philippines, Japan, Ceylon), and in 1909 accepted a post in the Rijksherbarium at Leyden. Of his phytophagical publications I select those on *Clematis* (3), *Passifloraceae* (4), *Ampelideae* (5), and *Acanthaceae* (6); he studied GAERTNER's *De fructibus* (7) and the botanical results of the ELBERT expedition (8) to the Lesser Sunda Islands and wrote 4 instalments of miscellaneous new or interesting plants from Malaysia (9). His later papers deal with a variety of subjects, either botanical, linguistic or ethnographical or all simultaneously. He wrote: (transl.) "Words grow like plants, chiefly at the end by adding various portions of words to the ancestral form; they may be said to branch in this manner. After this they die off as a rule near their beginning through careless enunciation and resemble a peat-layer consisting of numberless desintegrating individuals. Within this stage, their original meaning moves, as it were, from its beginning onto the dying stems and branches, reaches the final derivations and suppresses former meanings." More and more his work became steeped with the mysticism that, a quarter of a century later, wrought havoc in the German mind.

The severe disciplines of pure taxonomy and phytography could not hold his sometimes brilliant, fast-flying thoughts. He developed daring plant-geographical theories (10) which, while hitting the mark now and again (e.g. the inadequacy of WALLACE's Line in botanical problems), also went astray (e.g. exaggeration of Australian elements in the New Guinea flora, underestimation of the differences in the Formosan and Indo-Malayan vegetation). In addition, he endeavoured to construct a new vegetable system (11). His industry and penetrating intuitive mind largely counterbalanced a lacking sense of proportion but a perfectly adjusted and cautious awareness of relative values is essential for any attempt towards a general vegetable system. HALLIER's monophyletic construction is mainly different from other, then existing, systems in that he derived the Monocotyledons from the Dicotyledons accepting as linking families, the *Magnoliaceae*, *Berberidaceae*, *Ranunculaceae*, and *Nymphaeaceae*; these four held a position also between Monocotyledons and Gymnosperms.

More successful was his claim that phytochemistry might yield data establishing relationship between certain groups (12).

HALLIER served in the Leyden Herbarium from 1909 till 1922; he died in 1932 at Oegstgeest (near Leyden). His bold theories command attention. He drew his conclusions sometimes too quickly and on too slender evidence, and gave more freedom to his sentiments and instincts than is usually thought admissible in scientific problems, but those sentiments were never cheap, never low, and his intuitive views not infrequently proved to be surprisingly right.

*References:* (1) Bull. No 14, Mij Bev. Nat. Ond. Ned. Kol. (1894). Versl. 's Lands Plantent. (1894) 15-19, 56-58; Nat. Tijdschr. Ned. Ind. 54 (1895) 450-452; Naturw. Wochenschr. 11 (1896) *passim*; Ann. Jard. Bot. Btzg 14 (1897) 18-52; Engl. Bot. Jahrb. 49 (1913) 369-380; Beih. Bot. Centr. 34<sup>2</sup> (1916) 19-55. (2) Engl. Bot. Jahrb. 18 (1893) 81-160, 453-591; Versl. 's Lands Plantent., Bijl. 2 (1895) 125-132; Bull. Herb. Boiss. 5-7 (1897-1899) *passim*. (3) Ann. Jard. Bot. Btzg 14 (1897) 248-276. (4) Meded. Rijksherb. 42 (1922) (5) Nat. Tijd. Ned. Ind. 56 (1896) 300-331. (6) Nova Acta 70 (1897) 195-240. (7) Rec. trav. bot. néerl. 15 (1918) 27-122. (8) cf. J. ELBERT, Die Sunda Exp. 2 (1912) 275-302 and Meded. Rijksherb. Leiden 14 (1912) 1-42, *ibid.* 22 (1914) 1-20. (9) Ann. Jard. Bot. Btzg 13 (1896) 276-327; Bull. Herb. Boiss. 6 (1898) *passim*; *ibid.* II, 1 (1901) 667-676; Meded. Rijksherb. Leiden 25 (1915). (10) Bull. Herb. Boiss. II, 3 (1903) 306-317; Ber. Deutsch. Bot. Ges. 23 (1905) 85-91; New Phytol. 4 (1905) 151-162; Arch. néerl. Sci. exact. & nat. sér. III, 1 (1912) 146-234; Meded. Rijksherb. Leiden 44 (1922) 1-41. (11) cf. J. ELBERT, Die Sunda Exp. 2 (1912) 275-302; Meded. Rijksherb. 13 (1912) 32. (12) C. R. XI<sup>me</sup> Congr. Int. Pharm. 2 (1913) 969-978.

### 71. The 'Flore de Buitenzorg'

TREUB's third scheme for a local Flora was the *Flore de Buitenzorg*. This Flora was to cover the Buitenzorg region, for this purpose delimited as a tract of land beginning at Tandjong Priok and ending on the summit of Mount Gedeh. In this fashion the Flora would describe all plants indigenous in West Java, from the beach to the highest mountains. The Flora, when it was discontinued, consisted of 6 volumes, only one being devoted to Phanerogams (*Orchidaceae* by J. J. SMITH), and the majority appeared to be monographs of a much greater scope.

O. PENZIG, an Austrian botanist in charge of the Museum at Genoa, when visiting the Gardens to work in the Foreigner's Laboratory, declared himself prepared to elaborate the *Myxomycetes*. His results appeared in 1898 as the first volume, *Die Myxomyceten der Flora von Buitenzorg*.

The author of the second volume of the Buitenzorg Flora was M. RACIBORSKI, a Polish scientist arriving in 1896 on TREUB's invitation. He was an exceptionally good microscopist who, in the course of his career (1896-1900, Java; 1900-1917, in various Universities in Poland), worked very successfully in palaeobotany, histology, embryology, and physiology. His knowledge was exceedingly wide



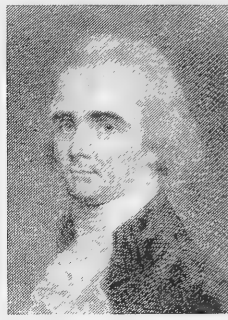
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and specialized on *Myxomycetes*, *Algae* and *Fungi*. His large work *Die Pteridophyten der Flora von Buitenzorg* (1898) proved him to be an able taxonomist and photographer who dealt in a remarkably short time with the numerous problems waiting him in this branch of Malaysian botany. He wrote, among many other subjects, on the mode of branching in the Nutmeg tree (1), on myrmecophily (2), on fossil *Pangium* (3), on parasitic and epiphytic toadstools of Java (4), on Javan *Uredineae* (5) and *Myxomycetes* (6), on the germination of Javan orchids, on *Vanilla*, on seeds of *Andropogon* etc. (7). He discovered that tobacco seeds required light for germination (8).

The third volume of the *Flore de Buitenzorg* appeared in 1900, written by É. DE WILDEMAN, under the title *Les Algues, essai d'une flore algologique de Java*, which did not even pretend to confine itself to the Buitenzorg region. DE WILDEMAN had laid the base for Malaysian algology by his *Prodrome de la Flore Algologique des Indes néerlandaises* (1897-'99). DE WILDEMAN, a Belgian scientist, devoted his later life mainly to the phytography of tropical African Phanerogams.

V. SCHIFFNER revised part of the liverworts in the fourth volume of the Flora of Buitenzorg: *Les Hépatiques* (1900). Two years before he had published a *Conspectus hepaticarum archipelagi indici*. Since VAN DE SANDE LACOSTE's early study *Synopsis Hepaticarum javanicarum*, of 1856, very little had appeared on the subject and the book was acclaimed as a most valuable and progressive contribution to Malaysian hepatology. SCHIFFNER, a Czecho-Slovakian, was a botanist in the Prague University until he accepted a temporary post in the Buitenzorg Herbarium (1893) to replace HALLIER. SCHIFFNER returned to Prague in 1895 and, from 1902 till 1932, occupied the Chair of Botany in the Vienna University. The *Hepaticae* in ENGLER & PRANTL's *Die natürlichen Pflanzenfamilien* (1st ed.) are also from his hand; in addition he wrote some separate articles on Malaysian *Hepaticae*.

Javan bryology was in particular studied by DOZY and MOLKENBOER in their *Bryologica javanica* (started 1855) which, after the death of its authors, had been continued (since 1870) by R. B. VAN DEN BOSCH and C. M. VAN DE SANDE LACOSTE. The 5th volume of the *Flore de Buitenzorg*, now,

proved to be a monograph of world importance issued in four parts (1904-'22).

MAX FLEISCHER, a Silezian, a considerable painter (several of his fine landscapes are kept in the Indisch Instituut at Amsterdam and portray the type localities of new species which he discovered and described), had published his first bryological paper in 1892. TREUB, wanting an artist who might do justice to the pictorial beauty of the Buitenzorg Gardens, and a scientist to write a volume on the mosses, made an excellent choice and found in FLEISCHER both faculties combined. In 1899, FLEISCHER came to Buitenzorg where he remained till 1902. In 1908 he came again to Java and returned in 1913 to Germany. His later years were divided between his science (Berlin-Dahlem) and his art; in 1928 he finally settled at The Hague, to die in the same year.

In the *Musci der Flora von Buitenzorg*, FLEISCHER at first followed pretty closely the manner of treatment of the earlier volumes of the *Flore* but, gradually, his views extended and his grasp on his subject tightened; the work grew to a revision of the *Musci Frondosi*. His new taxonomical conceptions were approved and generally accepted while his phytography was pointed and clear. The final instalment (4th) of the 5th volume only appeared in 1922.

The concluding volume, the only one dealing with Phanerogams, appeared in 1905, by J. J. SMITH. It was a treatment of all Javan *Orchidaceae*. This volume was supplemented by an *Atlas* (1908-'14). SMITH, the most important Dutch orchidologist wrote, at Buitenzorg, scores of other articles on various groups of Malaysian Orchids, the majority published either by the Buitenzorg Gardens or by the Rijksherbarium at Leyden (cf. (9) and § 96).

*References:* (1) Ann. Jard. Bot. Btzg II, 2 (1909) 1-67. (2) Flora 87 (1900) 38-45. (3) Bull. Acad. Sci. Cracoviae (1909). (4) RACIBORSKI, Parasitische Algen und Pilze Java's, 3 fasc. (1900); also Bull. Acad. Sci. Cracoviae (1909). (5) Bull. Acad. Sci. Cracoviae (1909). (6) Hedwigia 37 (1898) 50-55. (7) cf. also Flora 85 (1898) 325-361, and Bull. Acad. Sci. Cracoviae (1902-1909) *passim*. (8) Bull. Inst. Bot. Btzg 6 (1900). (9) Bibl. in Blumea, suppl. 1 (1937).

72. 's Lands Plantentuin 75 years; Valeton

A good survey of what had been achieved at Buitenzorg in the first 75 years of the Gardens is found in 's Lands Plantentuin te Buitenzorg (1892), particularly in its bibliography. I must confine myself to discussing the work of four more phyto-graphers of TREUB's time. They are TH. VALETON, S. H. KOORDERS, and C. R. W. K. ALDERWERELT VAN ROSENBURGH, and the phyto-chemist M. GRESHOFF.

VALETON, a native of Groningen, was appointed in the Gardens in 1892, for the elaboration of a work on arboreous plants of Java. He was a student of P. DE BOER's when he graduated on a thesis *Critisch overzicht der Olacineae* (1886). His pensive slow-acting personality, paired to an extremely kind character and often abstracted moods, made him less eligible for a successful career in the brisk colonial practice but marked him as a scientist whose sole accomplishment would be his work. In 1904, VALETON was appointed Head of the Buitenzorg Herbarium; a plan for a Flora of Borneo with HALLIER (§ 70) did not materialize. Apart from this main work (the *Bijdragen*, see § 69), his phyto-graphical work deals with *Zingiberaceae* and *Rubiaceae* chiefly. He also compiled a list of species from New Guinea *Plantae papuanae* (1). His weak health damped his progress all his life and, in spite of admirable efforts, not unfrequently got the better of him. Nevertheless, he wrote the major part of the *Bijdragen* with close attention and, usually, in an exemplary style making it the only authoritative work on the Javan Forest trees in existence. He died in 1929 (2).

References: (1) Bull. Dép. Agric. Ind. Néerl. 10 (1907). (2) Obit. in Bull. Jard. Bot. Btzg III, 11 (1930) 1-11, incl. bibl.

73. Koorders

S. H. KOORDERS, born at Bandoeng (Java), in 1863, was educated in Germany as a forester. In 1884 he left Europe and began work at Buitenzorg. An article on the embryology of *Tectona* (embryology being one of the prevalent scientific fashions of the day) introduced his forestry studies (1). In 1888, he edited the 2nd edition of FILET's dictionary (see § 60). In the same year, 1888, KOORDERS initiated a new method of collecting trees, suitable to improve phyto-graphy. Planning a forest Flora, he wished to escape from the incidental specimens gathered by travelling collectors which, as a rule and particularly in case of trees, lacked either fruit or flowers or both. He began to attach numbered tags to wildgrowing individual trees. The same individual, then, might be visited at various intervals and yield material for phyto-graphical purposes; a perfect sequence of data concerning trees in primeval forest thus was obtained. This method he completed by devising labels provided with numerous headings under which all thinkable properties of the plant could be noted. So, at last, KOORDERS's collections of 7200 selected and marked trees, in addition to the normal field collecting, resulted in

a Javan herbarium that perhaps has been equalled in size but never surpassed in the amount of valuable data contained in it. Finally, the 'Herbarium Koordersianum' consisted of c. 50,000 numbers, collected in Java, Sumatra, and Celebes.

In 1890, KOORDERS set out to write a Forest Flora of Java relying on his own specimens. We have seen that TREUB, in 1892, accepted the direction of the work and that TH. VALETON wrote the *Bijdragen* with the help of KOORDERS (§ 69).

KOORDERS's method of mapping and numbering trees for a prolonged observation drew wide attention and was adopted e.g. in the Philippines.

In 1891, he accompanied J. W. IJZERMAN on his Central Sumatra expedition. In 1895 the first report appeared: KOORDERS was first to discover and describe peats and peat forests in Sumatra (2). With J. G. BOERLAGE he wrote on his Sumatran plants (e.g. in *Icones Bogorienses*). A trip into the Minahassa (Celebes), in 1895, resulted in a 700-page book (3); this was his well-known Celebes report, which was illustrated, and supplemented in 1901, 1903, 1918, and 1920 (4). In 1903, a collection of wood samples, pertaining to the entries in the *Bijdragen*, was sent to J. W. MOLL at Groningen, the base of H. H. JANSSENIUS's work on the anatomy of Javan timbers (§ 109).

KOORDERS, charged with the writing of a mountain Flora of Java, published in 1911-13 his *Exkursionsflora von Java, mit besonderer Berücksichtigung der im Hochgebirge wildwachsender Arten* (3 vols). The work was compilatory, as was inevitable when a task of such a size was undertaken single-handed and when it had to be brought to an end within some years; yet, C. A. BACKER's passionate criticism (5), which claimed that it abounded in slips, omissions, and unwarranted statements, cannot be denied (6) and if a student of Javan botany felt gratified in having now for the first time in history a 'complete' Flora of the Phanerogams of Java, he soon saw his expectations come to nought when keys and descriptions failed him painfully often. An *Atlas*, or 4th volume, supplementary to the *Exkursionsflora* began to appear (1913) but scarcely justified the expense though it contained now and then valuable pictures. After KOORDERS's death (1919), his wife continued editing this *Atlas* (till 1925) and other works with unswerving loyalty. An *Atlas der Baumarten von Java*, illustrating the *Bijdragen* also was issued (1913-18, 3 vols). In 1918, the first instalments of an unillustrated *Flora von Tjibodas* (posthumously completed by his wife in 1923), to a certain degree tried to and did make amends for the tragic failure of the *Exkursionsflora*: the book is a useful and reasonably complete summary of the vegetation of the mountain flora of the Tjibodas region (Mt Gedeh).

KOORDERS's books, large though they are, present by no means a satisfactory picture of his phyto-graphy. Concurrent with the issue of the *Bijdragen* (§ 69), he wrote a series *Bijdragen tot de kennis der Boomflora van Java* (partly together with BOERLAGE) appearing in the 'Natuurkundig Tijdschrift voor Nederlandsch Indië' (c. 1900), and another series *Notizen über die Phanerogamenflora von Java*

(7). A sequence of 20 papers appeared under the title *Bijdragen tot de kennis der Flora van Java*, a register to this was published (8) in 1919. Preliminary to the *Exkursionsflora* he published on the mountain flora of Mt Tengger (9). His *Kleine Schetsen van merkwaaardige Javaansche planten* consists of 15 instalments (10). KOORDERS was a close observer, and described many morphological peculiarities in Malaysian plants which had not been recorded before. He made special studies e.g. of *Rafflesia* (based (11) on the work of ZU SOLMS-LAUBACH, cf. § 76), *Coffea* (12), of epiphyllous parasitic fungi (13). In 'Nova Guinea' (§ 106) he elaborated (14) several small families (e.g. *Taxaceae*). He published (15) on JUNGHUHN's inedited plants (cf. §§ 47, 48, 52) and was instrumental in founding the Netherlands Indian Society for the Protection of Nature (1912), of which he was a president till his death.

KOORDERS, in spite of some disappointing work, achieved so much and laboured so incessantly towards the progress of Malaysian phytophagy, that he will be remembered as an admirable explorer and a leader in his field. The *Systematisches Verzeichnis* (1910-14) forms the key to his collections, the 2nd to 5th parts (1914) contain the Sumatra, Celebes, and Lombok data.

References: (1) Nat. Tijd. Ned. Ind. 51 (1891) 141-200, also Engl. Bot. Jahrb. 21 (1896) 458-498. (2) Jahrb. Preuss. Geol. Landsamt 30 (1909) 398-443, cf. also Chapt. 2 and 3 in IJZERMAN, Dwars door Sumatra (1895), and Naturw. Wochenschr. (1907) 658-664. (3) Meded. 's Lands Plantent. 19 (1898) 1-716. (4) Nat. Tijd. Ned. Ind. 61 (1901) 250-261, *ibid.* 63 (1903) 76-89, 90-99, also Bull. Jard. Bot. Btzg III, 1-2 (1918-1920); cf. also Tijd. K.N.A.G. 12 (1895) 395-398. (5) BACKER, Kritiek op de Exkursionsflora (1913). (6) KOORDERS, Opmerkingen over eene Buitenzorgsche kritiek (1914). (7) Nat. Tijd. Ned. Ind. 60-63 (1900-1904) *passim*. (8) Bull. Jard. Bot. Btzg III, 1 (1919) 137-139. (9) Nat. Tijd. Ned. Ind. 60-62 (1900-1902) *passim*, also Teysmannia 11 (1900) 238-252. (10) *ibid.* 10-12 (1899-1901) *passim*. (11) KOORDERS, Bot. Overzicht der *Rafflesiaceae* (1918). (12) Teysmannia 10 (1899) 491-496; Koffiegids 1 (1900) 740-745; Ind. Mercur 23 (1900) 235; de Nieuwe Gids, Landb. Tijd. 3 (1901) 337-352. (13) Verh. Kon. Akad. Wet. Amsterdam 13 (1907) 1-264. (14) Nova Guinea 8 (1910-1914) *passim*. (15) Junghuhn Gedenkboek (1909).

#### 74. Greshoff and Treub

M. GRESHOFF, born in 1862 at The Hague, went to the East Indies in 1887 as a military apothecary but was soon attached by TREUB to the Staff of the Gardens to investigate the chemico-pharmacology of the vegetable substances of the colonies, in particular with a view to their medicinal properties (1889). GRESHOFF subsequently published a list of poisonous plants used for fishing (1), a famed handbook of tropical phyto-chemistry. Plant toxicology received another contribution by his *Indische Vergiftrapporten* (2).

GRESHOFF, by no means limiting his research to pharmacology, made a new edition of F. S. A. DE CLERCQ's *Nieuw Plantkundig Woordenboek voor Nederlandsch-Indië* (1909). DE CLERCQ, retired Resident of Ternate and of Riouw, succeeded in improving on FILET (§ 60) and KOORDERS's earlier works on native plant-names; alphabetically arranged scientific names of the whole of the Netherlands Indies were provided with carefully chosen vernacular names, and a large collection of native botanical sayings and proverbs made DE CLERCQ's book ethnobotanically important. GRESHOFF's finest phytophagical work is his admirable *Nuttige Indische Planten* (1894-1900), a series of 50 fine plates of Malaysian plants (drawn by W. CALMANN) inspired by Rumphian standards and so accompanied by careful descriptive notes. To these, he added a historical commentary of such excellence that this work may be said to have inaugurated the historico-botanical approach in Malaysia, a type of research that has made great progress since then and a branch of phytophagy still growing in our day. GRESHOFF died in 1909.

References: GRESHOFF, Beschrijving der giftige en bedwelmende planten etc. in Meded. 's Lands Plantent. 10 (1893), 29 (1900), and Meded. Dep. Landb. 17 (1913). (2) GRESHOFF, Ind. Vergiftrapp. 3 vols (1899, 1900, 1914).

#### 75. Van Alderwerelt van Rosenburgh

C. R. W. K. VAN ALDERWERELT VAN ROSENBURGH devoted his life to the study of Malaysian ferns after he had retired from the Army (1904) at the age of 41. He became Curator of the Herbarium, later Assistant, and wrote at Buitenzorg his *Malayan Ferns* (1908), a step forward as regards completeness after RACIBORSKI's pioneer work (§ 71). At first he lacked the somewhat firmer touch of later years and only gradually, never entirely, he detached himself from the authority of earlier writers. In 1915 he published *Malayan Fern Allies*, supplemented in 1917. His work is the first deliberate attempt to describe the ferns of Malaysia as a whole and as such, it has become and will remain basic to new study. There are also a series of papers entitled *New or interesting Malaysian Ferns* (1908-1922) and an elaboration of New Guinean pteridophytes (1).

VAN ALDERWERELT wrote also on Malaysian *Araceae* (2).

References: (1) Bull. Dép. Agr. Ind. néerl. 18-27 (1908-1909) *passim*; Bull. Jard. Bot. Btzg 2-12 (1911-1922) *passim*; Pteridophyta in Nova Guinea 14 (1924) 1-72. (2) Bull. Jard. Bot. Btzg III, 1 (1920) 338-350; *ibid.* 4 (1922) 163-229, 320-347; Nova Guinea 14 (1924) 210-220 (with K. KRAUSE).

#### 76. Visitors to Buitenzorg; Zu Solms-Laubach, Goebel, Schimper

Refraining from a survey of other aspects of botanical research at Buitenzorg when it rose to a leading phytophagical centre under TREUB, I wish, in retrospect but shortly, to refer to some visiting



SCHLECHTER



SCHUMANN



AIRY SHAW



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scientists and to the serial issues appearing in those years.

H. Graf ZU SOLMS-LAUBACH came in 1883 to Buitenzorg. He chiefly studied and described parasitic Phanerogams in *Rafflesiaceae* (1), *Hydnoraceae* (1), and *Balanophoraceae* (2). He also published papers on *Caricaceae* (3), *Pontederiaceae* (4), and *Pandanaceae* (5); in addition he did some research in Cryptogams. Most widely known became his investigations into palaeobotany (6).

K. VON GOEBEL, a German botanist, since 1889 editor of *Flora*, a periodical of foremost importance to Malaysian phytography among 19th century German journals, was in 1885 and in 1924-'5 in Java. A series of 15 studies, mainly on Cryptogams, appeared under the title *Morphologische und biologische Studien* (7). In these he wrote e.g. on ferns (*Polypodium*, *Marattiaceae*), liverworts, tropical *Cyperaceae* and *Gramineae*, *Utricularia*, and Javan *Urticaceae*, accentuating their biology. His main work is *Organographie der Pflanzen* (1st ed. 1898-1901, 3rd ed. 1928-'33); the work owes much to Buitenzorg.

A. F. W. SCHIMPER, born at Straatsburg, joined in 1898 the German 'Valdivia'-expedition under CHUN. He had done phytographical work on West Indian tropical epiphytes (8) and wrote also on pharmacological and cytological subjects. In 1888, he began a series *Botanische Mitteilungen aus den Tropen*, the first instalments dealing with West Indian epiphytes and myrmecophilous plants which, of course, was a qualification to the study of plant life in Malaysia when he arrived in 1889. His observations in Java led to a paper on foliage transpiration in 1890. A very important volume of the *Botanische Mitteilungen*, however, was 'Heft 3', *Der Indo-Malayische Strandflora* (1891). This work should be consulted in conjunction with K. G. BOOBERG's paper on the Malayan beach flora (10). SCHIMPER's physiological drought theory, propounded in his main work *Pflanzengeographie auf physiologischer Grundlage* (1898; repr. 1908), has drawn the attention for many years. He elaborated the *Rhizophoraceae* in the 1st edition of *Die natürlichen Pflanzenfamilien* (1892).

This summary of publications by botanists working at Buitenzorg, or studying Malaysian materials, who contributed to phytography inciden-

tally but did not describe plants with an intention of delimiting species and so of adding to taxonomy, might be considerably extended. After all, TREUB's institutions drew the attention of dozens of botanists. In this, and in the following paragraph, I have referred to those who, possibly, meant most to Malaysian phytography in TREUB's period.

*References:* (1) Bot. Zeit. (1874); Abh. naturf. Ges. Halle 13 (1875), Bot. Zeit. (1878); Ann. Jard. Bot. Btzg (1891), also *ibid.* Suppl. 2 (1898), Suppl. 3 (1909), and in Pfl. Reich (1901). (2) Abh. naturf. Ges. Halle 13 (1875). (3) Bot. Zeit. (1889), also in *Flora Brasiliensis* 106 (1889); Nat. Pfl. Fam. (1893). (4) in DE CANDOLLE, Monogr. 4 (1883). (5) Bot. Zeit. (1878); Linnaea 8 (1878); Ann. Jard. Bot. Btzg (1883); Nat. Pfl. Fam. (1888). (6) SOLMS-LAUBACH, Einleitung in die Paläophytologie (1887); also Mitt. philom. Ges. Elzasz-Loth. 3 (1906). (7) Ann. Jard. Bot. Btzg 7 (1888) *passim*, 9 (1891) *passim*, 36 (1926) *passim*, 39 (1928) *passim*. (8) Bot. Centr. Bl. 17 (1884). (9) Sitz. Ber. Kgl. Akad. Wiss. Berlin phys.-math. Cl. 40 (1890) 1-18, *ibid.* 103 (1894), and 104 (1895). (10) Bot. Jahrb. 66 (1933).

#### 77. Haberlandt, Tschirch, Koernicke; various other contributions

G. HABERLANDT, an Austro-Hungarian, came to Java on TREUB's invitation in 1891. His experiences are laid down in *Eine Botanische Tropenreise* (1893, 3rd ed. 1925). He belonged to the school of plant physiologists who assume a correlation between shape and function (1) and advocated his views in *Physiologische Pflanzenanatomie* (1884, 6th ed. 1924). He studied the leaflets of *Biophytum* (1885). In Java, his best work, possibly, was done on hydathodes (1) and on the nutrition of germinating mangrove plants (2).

A. TSCHIRCH, another of TREUB's guests, remained at Buitenzorg during 3 months (1888-1889) only. His stay there, however, made a deep impression and he went home with abundant materials for further study (*Indische Heil- und Nutzpflanzen und deren Cultur*, 1892). He became one of the foremost pharmacologists, and in that field of phytography distinguished himself by his *Handbuch der Pharmakognosie* (6th ed. 1925).

M. KOERNICKE reported on a trip to Java in

1908; he remained a lifelong friend of the Gardens. He wrote mainly on plant physiological subjects but also on the biology of *Loranthaceae* (3) and published a fine descriptive article on *Amorphophallus titanum* BECC. when it flowered in 1937 in the Botanic Garden at Bonn (4).

Reference could be made to literally hundreds of large or small studies containing, as a rule unintentionally, contributions to Malaysian phytophraphy, either made by visitors to Buitenzorg or by botanists who did not travel in Malaysia.

An extensive revision of *Cyperus* as occurring in the Malaysian Archipelago was written by J. VALCKENIER SURINGAR (5), illustrated by a number of fine plates by Miss J. DE WILDE, who as the author's wife in later years was to illustrate his treatment of New Guinean *Cyperaceae* (6) in 1912. VALCKENIER SURINGAR's only other direct contribution to Malaysian botany was a 3rd edition of a key to the tree species of the teak forests in Java by KOORDERS (7). As a Professor of Dendrology in the Agricultural College at Wageningen, he studied and published on many problems of nomenclature and the interpretation of the Rules (8).

J. P. LOTS, whose later works on taxonomy and the origin of species are more and more seen as worthy of the closest attention (9), wrote c. 1899, studies on *Gnetum*, *Balanophora* (*Rhopalocnemis*, with TH. VALETON) which have a secondary phytophraphical interest. The same applies to F. A. F. C. WENT, with WAKKER author of a book on sugarcane diseases and papers on Fungi. He published, when working at Buitenzorg, on the roots of climbers and epiphytes (1895), the branching of *Castilloa* (1897). From 1896–1934, WENT was Professor of Botany at Utrecht. Phytophraphy was not his main interest but he published on *Podostemaceae* (11). Many of WENT's earlier papers appeared in the 'Annales' of the Buitenzorg Gardens as did many others e.g. of J. C. SCHOUTE's on branching systems of Monocotyledons and Palms (1912), D. H. CAMPBELL's ontogenetic study in *Fern prothallia* (1907, 1908). There are P. H. ELKMAN and P. VAN ROMBURGH's pharmacological and phytochemical investigations, E. GILTAY's physiological research (1897), but it is impossible to try a wholly satisfactory summary of phytophraphical data scattered in the botanical literature of the time and there only present for other reasons than for the purpose of phytophraphy.

References: (1) HABERLANDT, Anatomisch-physiologische Unters. ü. tropische Laubblätter (1895). (2) Ann. Jard. Bot. Btzg 12 (1895) 91–116. (3) *ibid.* Suppl. 3 (1910). (4) Ber. Deut. Bot. Ges. 55 (1937). (5) VALCKENIER SURINGAR, Het geslacht *Cyperus* in den Maleischen Archipel (1895). (6) Nova Guinea 8 (1912) 695–713. (7) VALCKENIER SURINGAR, Determinatie tabel der Boomsoorten, welke in de djatiwouden op Java voorkomen (1915). (8) Med. Rijksherb. 55, 56, 57 (1928). (9) LOTS, Vorträge über botanische Stammesgeschichte 3 vols (1907, 1909, 1911); Vorlesungen über Descendenztheorien 2 vols (1909), and Evolution by means of hybridization (1916). (10) Ann. Jard. Bot. Btzg 16 (1899) *passim*. (11) Rec. trav. bot. néerl. 25 (1928) 475–482; Trop. Natuur 19 (1930) 53–60.

## 78. Exploring phytophraphers in Malaysia; Beccari, Warburg

O. BECCARI, an Italian explorer of inexhaustible energy, an ardent and most successful collector besides being a biologist and phytophrapher of exceptional gifts, visited Malaysia repeatedly between 1865 and 1877. He was thus a visitor of SCHEFFER's but published his works in TREUB's time. His 3-volumed *Malesia* (1877–1890) is of first importance, both as regards systematics and in its biological observations (e.g.  *Icacinaceae*,  *Menispermaceae*,  *Nepenthes*,  *Palmae*). His collections from Sumatra ('Piante sumatrense') and still more those from Borneo ('Piante bornense') were examined by every student of Malaysian botany and many are the bases of first descriptions. He was the earliest describer of myrmecophilous plants in Malaysia (1885), and of *Araucaria* in New Guinea. His travels in Borneo are told in the botanically highly interesting *Nelle foreste di Borneo* (1). Three times he went on expedition into New Guinea. His fame as a phytophrapher rests to a large extent on his numerous papers on Palms; I confine myself to mentioning his Palm study in *Reliquiae Schefferianae* and his splendid series on *Asiatic Palms* in the 'Annals of the Botanic Gardens, Calcutta' (parts I–III, 1908–1918). In 1869 he founded 'Il Nuovo Giornale Botanico Italiano', a periodical containing several contributions to Malaysian phytophraphy.

O. WARBURG, in some respects, was the German counterpart to O. BECCARI. In 1885–6, he visited Java and studied (lianas) at Buitenzorg during nearly a year. In many of WARBURG's later publications reference is made to his observations at Buitenzorg. He travelled for another two years in East Asia, went anew in 1888 to Malaysia and returned to Germany in 1889 after a visit, among several other trips, to Ceram laut and New Guinea (Kaiser Wilhelmsland, Finschhafen, Astrolabe Bay). The results were partly embodied in a *Beitrag zur Flora von Kaiser Wilhelmsland* (1894), one of several papers on F. HELLWIG's, U. M. HOLLRUNG's, and his own collections (15,000 numbers from Malaysia!) augmented by some materials from the 'Gazelle' expedition, secured in the Finisterre mountains (2). His most important contribution is *Beiträge zur Kenntnisse der Papuanischen Flora* (3) in which many new species were described.

In 1921, he migrated to Palestine, his second fatherland where, after a most successful career as a systematist, phytophrapher, and economic botanist, he died in 1938.

He was the editor and founder of the 'Der Tropenpflanzer', or 'Zeitschrift für tropische Landwirtschaft' (1897–1922), and author of classical monographs (*Die Muskatnusz*, 1897, *Monographie der Myristicaceen*, 1897). In 1900, he began a periodical 'Monsunia', more or less intended to emulate BECCARI's *Malesia*, but after a first volume it was discontinued.

To the *Fragmenta Florae Philippinae*, published by J. PERKINS, he contributed a considerable number of family elaborations (1904, '05).



The *Pandanaceae* in *Das Pflanzenreich* are from his hand (1900).

WARBURG was much occupied with plant-geographical problems. He investigated the Papuan flora with ardour (*Die Flora des Asiatischen Monsungebietes* (4) and *Vegetationsschilderungen aus Südost-Asien* (5)). His conclusion was, after studying the distribution of plants of eastern Malaysia, that 'Papuasia' represented a distinct plant-geographical unit and that New Guinea was but an early SE. Peninsula of the Asiatic Continent. He stressed the importance of Torres Straits as a plant geographical demarcation line (3).

*References:* (1) BECCARI, *Nelle foreste di Borneo* (1902), Engl. transl. *Wanderings in the great forests of Borneo* (1904). (2) Engl. Bot. Jahrb. 16 (1892) 1-32; *ibid.* 18 (1894) 184-212, (3) *ibid.* 13 (1891) 230-455. (4) Verh. Ges. Deut. Nat. f. Ärzte 3 (1890). (5) Bot. Jahrb. 17 (1893) 169-176.

#### 79. Periodicals in Treub's time

Apart from already mentioned serials and those continuing an issue starting previous to TREUB's arrival (§§ 55, 69; an index to the 'Annales', vols 1-30, in 'Supplement 4'), there appeared during TREUB's term of office some more periodicals of interest to phytography in the Netherlands East Indies.

Since 1890, 'Teysmannia' was edited under the auspices of the Gardens, a journal devoted to horticultural interests though phytographical contributions were not infrequently included. In 1922 'Teysmannia' was incorporated with the 'De Indische Cultures'. The several aspects of forestry were discussed in 'Tectona' appearing since 1908. In that same year the 'Proefstation voor de Thee' began its series of 'Mededeelingen'. The 'Archief

voor de Java Suikerindustrie', since 1893, was run without TREUB's intermediary. On the other hand, TREUB's activities led, indirectly, to the issue of the famed serial 'Nova Guinea'. This was published by the 'Maatschappij tot Bevordering van het Natuurkundig Onderzoek der Nederlandsche Koloniën' and embodied the beautifully illustrated results of old and recent Dutch expeditions into New Guinea. Volumes 8, (1909-'14), 12 (1913-'17), 14 (1924-'32), and 18 (1916 →) so far have been devoted to systematic botanical contributions; volume 1 contains a history of New Guinean exploration (*cf.* § 106).

The series of illustrations and descriptions: 'Icones Bogorienses', mentioned before, appeared from 1897 till 1914, when the issue was abandoned on account of World War I (§ 68).

The 'Bulletin de l'Institut Botanique de Buitenzorg' (sér. I, 1898-1905) changed its name in 'Bulletin du Département de l'Agriculture aux Indes Néerlandaises' (1905-'11) when the Gardens became temporarily, as an extended institution, the Department of Agriculture.

The photography executed in the institutions for applied botany, if the subject under study required this, is mainly contained in 'Mededeelingen uit 's Lands Plantentuin' (75 instalments, 1884-1904) continued as 'Mededeelingen van het Departement van Landbouw' (18 instalments, 1905-'14); these two series also comprise the *Bijdragen tot de kennis der boomsoorten* (*cf.* § 69).

A source of references to Malaysian phytographical literature is found in the first Catalogue of the Central Library ('Bibliotheca') at Buitenzorg prepared in 1887; a second edition followed in 1894, after which additions were listed in supplements to the annual reports of the Gardens (1895-1919), or separately issued (after 1920).

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## A. THE PHILIPPINES

80. *Phytography in the Philippines;*  
*Vidal and Rolfe*

In the Philippines (cf. § 56), progress was during these years less remarkable. S. VIDAL Y SOLER, after his *Catálogo metodico* of the ligneous plants of Manila province (1880), published by the 'Comisión de la flora y estadística forestal de las Islas Filipinas' which he presided since 1876, continued his Spanish descriptive studies by a *Sinopsis de familias etc.*, in 1883, a study on *Phanerogamae Cumingianae Philippinarum* (1885), and a *Revision de plantas vasculares filipinas* (1886). VIDAL's books suffer from a lack of critical research caused, it would seem, rather by the slender resources available at Manila at the time than by lack of insight. He was the first in the Philippines to realize that collaboration with, and comparative studies in, European herbaria was imperative when real progress was desired; he founded a herbarium and a library which were both destroyed by a fire in 1897. VIDAL died in 1889, a worthy precursor of Philippine phytography as it developed fifteen years later.

R. A. ROLFE, a Kew botanist who assisted VIDAL there (1883), wrote a *Supplementary list of Philippine plants* (1) as a completion of the *Novissima Appendix*. He published numerous small papers, mainly on Orchids (2), and an important study in Philippine phytogeography (3).

The pretentious 3rd edition of BLANCO's *Flora de Filipinas* (1877-1883) mentioned above, falls in this period, the first three volumes being a verbatim reprint of the 1845-edition, and the fourth reprints of LLANOS's papers and a first edition of FATHER I. MERCADO's 16th century study in medicinal plants; this latter volume also contains the *Novissima Appendix* by FATHER C. FERNANDEZ-VILLAR and A. NAVES; MERRILL stated that 44 per cent of the species ascribed to the Philippines do not occur there at all.

The closing decades of the 19th century, in strong contrast with the greater part of Malaysia, yielded in this manner but little phytography of importance; but collections grew satisfactorily (Luzon, A. LOHER and, general, O. WARBURG). An account of collectors is found in volume 1 of this *Flora*, and another (general) survey of 'botanical work in the Philippines' was published by MERRILL in 1903. In the turbulent years 1896-1899 (rebellion, Spanish-American war) fires and looting caused the destruction of all literature and herbaria available in the public institutions in the Philippines.

*References:* (1) J. Bot. 23 (1885) 209-216. (2) Gard. Chron. 26 (1886) *passim*; J. Linn. Soc. Bot. 25 (1889) 211-240; Kew Bull. (1892, 1894, 1908, 1917) *passim*. (3) J. Linn. Soc. Bot. 21 (1884) 283-316.

81. *Merrill*

An uncertain rebirth of botanical research occurred in 1900 when the Forestry Bureau was opened. A new area started, however, in reality

when the Philippine Bureau of Agriculture was established at Manila in 1902 and when, in the same year, E. D. MERRILL arrived.

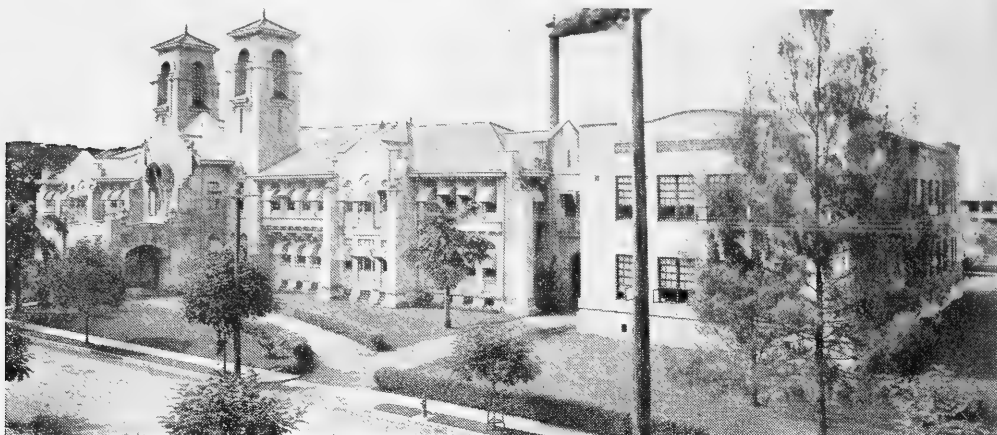
MERRILL was originally an agrostologist and had hardly any experience qualifying him for a leading position in Philippine botany. Being three times asked to accept appointment at Manila and replying that somebody familiar with Philippine botany ought to be sent, he was informed that there was nobody qualified, and that for this reason he might fill the post as well as anybody else. The outcome was that he accepted and that he made Philippine phytography in the course of twenty-five years at least an equal to what was found anywhere else in the tropics.

In 1903, re-organization brought the 'Bureau of Government Laboratories' into being which became the centre of botanical research in the Philippines for some years; in 1906 this institution was extended and the name changed to 'Bureau of Science'.

As this is not the place to discuss MERRILL's splendid achievements, as botanist or Director (1919-'23) of the Bureau, Professor in the University of California (1924-'29), Director of New York Botanical Garden (1930-'35), or Administrator of Botanical Collections, Harvard University (1935-'47), it is fortunate that, in 1946, in celebration of the 70th birthday of this 'American Linnaeus', a book appeared, *Merrilleana*, which gave an anthology from his works, a life history, and a bibliography. This special issue of *Chronica Botanica* ranks with the most informative works connected with Malaysian phytography published in this 'international collection of studies in the method and history of Biology and Agriculture'.

MERRILL's chief taxonomical and descriptive works are, as regards Malaysia: *Flora of Manila* (1912), *A bibliographic enumeration of Bornean plants* (1921), *An enumeration of Philippine flowering plants* (1923-'26), and *Plantae Elmerianae Borneenses* (1929). In 17 instalments appeared *New or noteworthy Philippine plants* (1). The historicobotanical method of research yielded under his hands a surprisingly large crop of handbooks: *An interpretation of Rumphius's Herbarium Amboinense* (1917), *Species Blancoanae* (1918) and *A commentary on Loureiro's Flora Cochinchinensis* (1935). I leave unmentioned several smaller studies, apart from accounts of OSBECK's, N. L. BURMAN's, and HOUTTUYN's plants (cf. §§ 27, 34). A standard reference work is *A Bibliography of eastern Asiatic Botany* (with E. H. WALKER, 1938); indispensable are also his bibliographies, of *Polynesian botany* (1926), of *Philippine Flowering Plants* (1926), and of the *Islands of the Pacific* (1947, with E. H. WALKER).

Several studies, some already mentioned, testify of MERRILL's attention to Bornean phytography (§ 102). Many new Philippine species were published in his contributions to the 'Philippine Journal of Science'. New Guinean discoveries by the ARCHBOLD expeditions were described by him, together with L. M. PERRY, in the 'Journal of the Arnold Arboretum' (1939-'45 cf. § 106). Sumatran materials were studied in the series *New Sumatran*



The Bureau of Science at Manila  $\pm$  1923. The Herbarium occupied part of the wings

*Plants*, published in the 'Papers of the Michigan Academy of Science' (§ 101), in the *Enumeration of the plants collected by W. N. and C. M. Bangham* (1934) and the account of the botanical results of G. VANDERBILT's Sumatran expedition (1940). The bibliography in *Merrilleana* may be consulted for further data on these and other subjects.

MERRILL created modern Philippine phytography and, besides, succeeded by a most effective administration and organization to assemble a large and excellent Herbarium and Library at Manila. A considerable percentage of specimens were contributed by the Bureau of Forestry in a similar manner as in the Netherlands Indies, where the 'Dienst van het Boschwezen' brought together for economic purposes ten thousands of specimens of forest trees but of which duplicates were ceded to the Herbarium of 's Lands Plantentuin at Buitenzorg for taxonomical studies.

It was a great loss when, in 1945, the disasters of war caused, once again, the destruction of the Manila collections. Most fortunate, the wise policy of a liberal distribution of duplicates opens the possibility of recovering from various other Herbaria the greater part of the data once contained in the Manila Herbarium.

*References:* (1) Bur. Sci. Publ. Manila 6, 17 (1904), also 29, 35 (1905); Philip. J. Sci. Bot. 1-20 (1906-1922) *passim*.

#### 82. Perkins, Elmer, Ames

A group of distinguished phytographers worked with MERRILL, or at least integrated their studies with his publications.

Miss J. PERKINS, independently, published *Fragmenta Florae Philippinae* (1904-'05); three fascicles appeared of descriptions based chiefly on AHERN, JAGOR, LOHER, MERRILL, and WARBURG's collections. In collaboration with E. GILG, the *Monimiaceae* were elaborated by her as an instalment of *Das Pflanzenreich* (1901, *Nachträge*, 1911).

A. D. E. ELMER, a private collector who made a living out of the sale of botanical collections secured the 'largest single collection made by anyone individual' in the Philippines. He described his finds (sometimes helped by collaborators) in his *Leaflets of Philippine Botany* (1906-'39), which contain *e.g.* a number of local studies flora of Mt Apo, Mt Urdaneta, *etc.*). He made also a collecting tour in British N. Borneo.

OAKES AMES, working during a lifetime in Harvard University (U.S.A.) specialized in *Orchidaceae* and, in particular between 1905 and 1920, wrote a number of papers on Philippine Orchids. Recently, an anthology from his work and bibliography was published as *Orchids in retrospect* (1948).

#### 83. Descriptive studies of Philippine economic plants

H. N. WHITFORD concentrated on the forest resources of the Philippines; phytographically are to be considered *The Vegetation of the Lamao Forest Reserve* (1) and *The forests of the Philippines* (2). He was a forester of the Forestry Bureau at Manila (1904-'12). W. H. BROWN compiled an illustrated cyclopaedia of the *Minor products of the Philippine forests* (3 vols) and on useful plants (3); he collaborated with A. P. WEST (4), with A. F. FISCHER on mangrove and bamboos (5), with D. M. MATTHEWS on *Dipterocarpaceae* (6), and with MERRILL on palms (7). The 'Bulletin of the Philippine Bureau of Forestry' afforded these and similar studies an opportunity to appear in print. The series of notable contributions to Philippine forestry (*e.g.* Gymnosperms and *Dipterocarpaceae* by F. W. FOXWORTHY, Assistant for Dendrology at Manila University (1911-1918) prior to his appointment in the Federated Malay States, are partly phytographical and partly economic; the majority appeared in the 'Philippine Journal of Science' (8).

Philippine food plants and cultivated fruit were

described by P. J. WESTER in the 'Philippine Agricultural Review', issued since 1908 by the Philippine Bureau of Agriculture (9).

*References:* (1) Philip. J. Sci. Bot. 1 (1906) 373-431, 637-782. (2) Philip. Bur. For. 10, 2 parts (1911). (3) *ibid.* 22, 3 parts (1920-1921). (4) *ibid.* 20 (1920) 224. (5) *ibid.* 15, 17 (1918), repr. *ibid.* 22. (6) Philip. J. Sci. Bot. 9 (1914) 413-561. (7) Philip. Bur. For. 18 (1919), repr. *ibid.* 22. (8) Philip. J. Sci. Bot., 2-4, 6, 13 (1907-1918) *passim*, also Leaflet. Philip. Bot. 6 (1913) 1949-1958. (9) Philip. Agric. Rev. 9 (1916) 150-256; 14 (1921) 211-384, repr. Philip. Bur. Agric. Bull. 39 (1924) 1-236.

#### 84. *Pteridophytes described in the Philippines*

H. CHRIST, apart from his *Die Farnkräuter der Erde* (1897), devoted some research to Philippine pteridology. He elaborated the LOHER collections (1), made a local monograph of Philippine *Dryopteris* and repeatedly returned to further study of Malaysian ferns (2). Ferns were also the chief subject of E. B. COPELAND's numerous phytographical papers; in addition he wrote on *Fungi* and some plant physiological papers (1905-'20). COPELAND worked from 1903 till 1917 at Manila and then accepted a professorship in the University of California. In 1929 he published *The oriental genera of Polypodiaceae*. His last work is a *Genera Filicum* (1947).

*Selaginella*, in particular of the Philippines, was studied by G. HIERONYMUS (3), who wrote also on *Rafflesia* (4) and a number of fern genera (5). W. HERTER specialized in *Lycopodium* (6).

*References:* (1) Bull. Herb. Boiss. 6 (1898) 127-154, 189-120; *ibid.* 6 (1906) 987-1011. (2) cf. Ann. Jard. Bot. Btzg (1896, 1898, 1904, 1906). (3) Hedwigia 41 (1902) 170-202; Fedde Rep. 10 (1911) 41-53, 97-116; Leaflet. Philip. Bot. 6 (1913) 1987-2064. (4) Gartenflora 34 (1885) 1-7; Bull. Congr. Int. Bot. St Petersburg. (1885) 35, 36; HIERONYMUS, *Ueber Rafflesia Schadenbergiana* (1885). (5) Hedwigia 54, 55, 57, 59-61 (1914-1919) *passim*. (6) Bot. Jahrb. 43 (1909) Beibl. 98, p. 1-56; Hedwigia 49 (1909) 88-92; Bot. Arch 3 (1923) 10-29; Philip. J. Sci. 22 (1923) 57-76.

#### 85. *Philippine periodicals; Quisumbing*

In 1906, the 'Philippine Journal of Science', a periodical issued by the 'Bureau of Science' (successor to the 'Bureau of Government Laboratories', which had 36 'Bulletins' to its name, several with phytographical contributions) was destined to receive the greater part of Philippine plant description. (cf. § 81). A special section Botany was set apart (vols 1-13), but since 1919 botanical papers were published among those on other subjects of natural history. The Pacific war interrupted the publication of volume 76 in 1941, an almost entirely destroyed edition appeared in the years of occupation (1), but the 'Journal' was resumed in April 1947. E. QUISUMBING, now Director of the National Museum where a new Philippine Herbarium is to be housed, is in charge of the 'Journal'

(to which he has contributed in collaboration with MERRILL and which contains many of his own phytographical publications, mainly on Orchids (1) and partly written jointly with O. AMES). Dr QUISUMBING also edits the 'Philippine Orchid Review', appearing since June 1948. He is the author of studies on Philippine bananas (2), a paper on Philippine weed seeds (3), descriptions of new Philippine plants (4), a monograph of *Piperaceae* (5), and of various other papers.

*References:* (1) e.g. Philip. Journ. Sci. 41 (1930) 315-371; *ibid.* 74 (1941) 175-185; *ibid.* 76 (1941) 81-97; *ibid.* 76 (1944) 37-55; *ibid.* 77 (1947) 1-18. (2) Philip. Agric. Rev. 12 (1919) 1-90. (3) *ibid.* 16 (1923) 1-53. (4) Philip. Journ. Sci. 37 (1928) 133-213, also *ibid.* 41 (1930) 315 and 56 (1935) 313-317. (5) *ibid.* 43 (1930) 1-246.

#### B. THE MALAY PENINSULA

##### 86. *Phytography in the Malay Peninsula till Ridley's arrival*

The Singapore Gardens had grown to a considerable park under the stimulus of horticultural and public interests since 1859. When Sir J. D. HOOKER sent in 1875 H. J. MURTON to act as Superintendent, a more scientific spirit was instilled into the Singapore Gardens. Till 1874 they were the property of the Singapore Agri-Horticultural Society but in 1878, the Raffles Library and Museum were charged with their upkeep and, the next year, R. CAMPBELL was appointed to take care of the Gardens. Though MURTON had a lively interest in matters botanical (he compiled a manuscript flora of the island which disappeared together with the major part of his herbarium), his erratic activities achieved but little. He remained with the Gardens till 1880 and died in 1881 at Bangkok. Nevertheless, due to his efforts, many introductions enriched the collections, the identification of the species in cultivation was in an advanced stage, and a valuable herbarium had been secured; in addition a Garden Catalogue compiled by MURTON had been printed but was not made public as N. CANTLEY, in charge since 1880, suppressed it. A curious parallel is found in the story of S. BINNENDIJK's suppressed Catalogue at Buitenzorg of 1854 (§ 53).

As in the Netherlands East Indies, the need became apparent for smaller institutes in regions remote from the central establishment, and so, for the third time, a botanical Garden was opened at Penang (1884), the so-called 'Waterfall Garden'. At Kuala Lumpur (Kepong) a Herbarium was assembled and maintained by the Forestry Research Service (since c. 1927; the Perak Museum is mentioned in § 89).

CANTLEY, a Kew Gardener, was Superintendent at Singapore from 1880 till 1888, a diligent collector who arranged the Garden anew and extended its Staff (*Guide to the Botanic Gardens*, 1889, by W. FOX, latest *Guide* by I. H. BURKILL), grounds, and buildings; he initiated methodical Forest Research in the Peninsula. In 1889, H. N. RIDLEY was appointed as Director.

## 87. King's 'Materials'; PRAIN

The commencement of RIDLEY's most fruitful term of office coincided with the issue of the central 19th century phytographical work on the Peninsular flora: G. KING's *Materials for a flora of the Malayan Peninsula*, which appeared in the 'Journal of the Asiatic Society of Bengal' in 21 parts (4 vols, 1889–1900). KING was helped by some collaborators but most of all by D. PRAIN, and together they made the *Materials* into a basis for all future systematic studies of this province. Its genuine quality, its close and skilful descriptions, its effective keys have never been improved upon. KING, during many years Superintendent of the Royal Botanic Garden at Calcutta, in particular made a study of *Ficus* and monographed this exceedingly difficult genus (1). He also elaborated the *Magnoliaceae* (2), the Indo-Malayan species of *Quercus* and *Castanopsis* (3), the *Annonaceae* and the genus *Myristica* in British India (4), and historical botany owes him several most informative studies into the past of Indian Botany (5). KING may have been aware that the inclusion of the flora of the Malay Peninsula in HOOKER's *Flora of British India* was not only unwarranted from a plant geographical point of view but that the state of knowledge and the manner of treatment produced an unsatisfactory result as regards the data and conclusions concerning the species of the Malay Peninsula, and that a fresh approach was desirable.

D. PRAIN began his Indian career as a medical officer in the Army but was appointed at Calcutta Botanic Garden in 1887 where he served under KING till 1898 when he, himself, became Director. In 1905, he accepted the Directorship of Kew Gardens which post he held till 1922. PRAIN is one of the most prominent phytographers of the Indian but also of the Malay Peninsula both as regards the quantity and quality of his works. In addition to his standard elaboration of the *Leguminosae* in the *Materials* and his work on *Index Kewensis* (supplements 3, 4, and 5), there came to be widely appreciated his monographic work on various genera of *Leguminosae* (*Dalbergia* (6), *Pterocarpus* (7), *Ormosia* (8), *Afzelia* (9), etc.).

In collaboration with I. H. BURKILL he wrote the sumptuously edited *Dioscoreaceae* monograph (2 parts) in the 'Annals of the Calcutta Gardens' (1936–1939) after they had prepared the field either single-handed or together by a number of preliminary papers on the same subject (10).

The Monocotyledons as a section of the *Materials* were elaborated by RIDLEY, who showed in the earlier part of his career a predilection for that class of plants. They appeared as a separate issue in 1907–08. Volume 5 of the *Materials* was composed by J. S. GAMBLE, who continued editing the work until, in 1936, the issue of a fascicle of some genera of *Euphorbiaceae* by his collaborator A. T. GAGE, brought this volume, and the issue of the work, to an end.

*References:* (1) Ann. Roy. Gard. Calcutta 1, 2 parts (1887–1888). (2) *ibid.* 3 (1891). (3) *ibid.* 2 (1889). (4) *ibid.* 3–4 (1891–1893). (5) *ibid.* 5 (1895);

J. Bot. 37 (1899) 454; Gard. Chron. 26 (1889) 252–254. (6) J. As. Soc. Beng. 70<sup>2</sup> (1901) 39–65, and Ann. Roy. Bot. Gard. Calcutta 10 (1905) 1–114. (7) Indian For. 26 (1900) 1–16. (8) J. As. Soc. Beng. 4 (1908) 447–457; Leaflet Philip. Bot. 5 (1913) 1589–1599; J. As. Soc. Beng. 10 (1914) 1–41. (9) Sci. Mem. Med. Off. Army India 12 (1901) 1–17. (10) Ann. Roy. Bot. Gard. 14 (1936–1939) 1–528.

## 88. Ridley

As was mentioned in § 86, RIDLEY came in 1889 to Singapore as the Director of Gardens, Straits Settlements. So far, the phytography of the Malay Peninsula had found a refuge outside the region (*cf.* § 87). A first step towards a medium for plant description within the Peninsula was put when, in 1891, RIDLEY founded the 'Agricultural Bulletin of the Straits and Federated Malay States', which was discontinued in 1912 and in 1913 re-appeared as the 'Gardens' Bulletin Straits Settlements'. This 'Bulletin' after an interruption from 1941 till 1947, concluded its 11th volume in the latter year.

The 'Gardens' Bulletin' celebrated in 1935 by a special 'Dedication Number' RIDLEY's 80th birthday and, along with many articles on various subjects, presented a list of his very numerous and diversified publications. RIDLEY travelled far and wide over the Peninsula assembling vast collections; he also explored parts of Sumatra (Djambi, Brastagi). Passing by many, the following titles are mentioned here. The *Prodrum florae timorensis* in FORBES's *Wanderings* (1885) as regards the Monocotyledons (1) is from RIDLEY's hand. Further work on Monocotyledons is *e.g.* Monocotyledons of New Guinea (2), in the paper on the flora of the Eastern Coast (3), Enumeration of Bornean *Orchidaceae* (4), Grasses and Sedges of Borneo (5), etc.; it appears also from these titles that RIDLEY had a lifelong interest in the Bornean flora while his additions to Bornean phytography have continued till the present day (6). He elaborated a number of monocotyledonous families in HANS WINKLER's *Beiträge* to the knowledge of the Bornean flora (7).

To Sumatran phytography RIDLEY added *e.g.* by describing and listing the collections of C. BODEN KLOSS (8) who had explored the Mt Kerinci region, of MOHAMMED NUR (9) made in Upper Deli, and of C. J. BROOKS of Bencoolen (10). A large paper appeared (11) on the botanical results of the WOLLASTON expedition to Dutch New Guinea (1912–1913). He also studied the flora of Lower Siam (12).

On the plants of the Mentawai Islands, he wrote *Spolia Mentawaiensis* (13). The *Scitamineae* of the Philippines had his early attention (14). His participation in KING's *Materials*, I referred to in § 87; he described the flora of Christmas Island (*cf.* § 64).

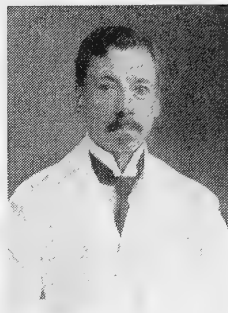
RIDLEY made a Flora of Singapore (15), discussed the fruits of the Malay Peninsula (16), its timbers (17), drugs (18), composed a *Flora of Telom and Padang Valleys* (19), and described the flora of Mt Tahan (20); he reported on expeditions to Upper Perak (21) and discovered the fundamental im-



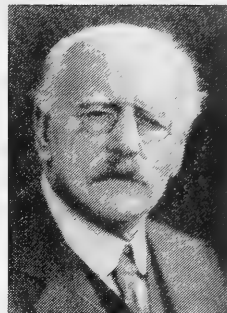
VAN SLOOTEN



A. C. SMITH



J. J. SMITH



STAFF

portance to plant geography of the Kra Isthmus (1911).

He published a considerable study on the ferns of the Peninsula (22). Historical papers (few exist on the botany of the Malay Peninsula) were devoted to Agriculture (23), the botanical Gardens (24), and the scientific exploration of the Peninsula (25). I may conclude this brief summary by *Spices* (1912) and *Dispersal of Plants throughout the world* (1930), both authoritative handbooks. RIDLEY's largest publication, though not his best, is the *Flora of the Malay Peninsula* (5 vols, 1922-'25).

RIDLEY proved himself a most diligent collector and tireless worker (*cf.* bibliography, 26); phyto-graphically his publications are unstable, now he is explicit and generally dependable, then again his descriptions are succinct to such a degree that desirable details are omitted and they appear to have suffered from errors due to hastiness. In particular his keys show shortcomings which he could have avoided. As it is, RIDLEY's capability as a research worker (he developed the modern method of rubber tapping!) and his power to demonstrate by his publications the practical and beneficial effects of phytography on plant science in all its aspects, convinced adversaries and succeeded in a surprisingly short time in pushing Singapore Gardens to the fore, as a centre of Malaysian phytography emulating and well matching their so much older sister institution at Buitenzorg.

This account of progress in the Malay Peninsula so far may have conveyed the idea that RIDLEY's general Flora was built on the data supplied by the *Materials*, by his own great collections and by his research; this was largely the case but, actually, a consideration of the phytography executed in the region proves that more sources could be drawn from. It may be true that local or district Floras should preferably follow the general Flora in any plant geographical area of great size, because a general outline and survey is necessary to place the details in the best manner, but in practice this never happens. Systematists confronted with a rapidly increasing mass of new data emerging from a little explored region which is, at a certain period, laid open to botanical investigation, usually feel that the available data are too incidentally picked and that too large 'blank spaces' remain, to justify

a general Flora. Writing often in institutes far from the scene of discovery, they prefer to elaborate the materials they have in hand and their results appear as lists or as a 'botany' of a certain expedition or, eventually, as a district flora, which may lack the perfection attainable at some future date after the whole will have been arranged in a general Flora, but which has often the merit of supplying valuable facts and, not infrequently, basic information, while it has the weighty advantage of offering an early directive for further research. And so, when RIDLEY's Flora began to appear, there had been published, apart from the *Materials*, some local Floras which continued to appear when this general Flora was in the course of publication.

*References:* (1) Suppl. in J. Bot. 63 (1925) suppl. 115-127. (2) J. Bot. 24 (1886) 321-327, 353-360. (3) Trans. Linn. Soc. Bot. ser. 2, 3 (1893) 267-408. (4) J. Linn. Soc. Bot. 31 (1896) 261-306. (5) J. Roy. As. Soc. Str. Br. 45 (1906) 215-228. (6) Kew Bull. (1912-→) *passim*. (7) Engl. Bot. Jahrb. 44 (1910) 518-532. (8) J. Fed. Mal. St. Museum 8 (1917) 9-145. (9) J. Roy. As. Soc. Mal. Br. 1 (1923) 46-115. (10) Kew Bull. (1925) 76-94. (11) Trans. Linn. Soc. Bot. II, 9 (1916) 1-284. (12) J. Roy. As. Soc. Str. Br. 59 (1911) 15-234. (13) Kew Bull. (1926) 57-94. (14) Govt. Lab. Philip. Publ. 35 (1905) 83-87. (15) J. Roy. As. Soc. Str. Br. 33 (1900) 27-196; *ibid.* 35 (1901) 84-90. (16) Agric. Bull. S.S. and F.M.S. 1 (1902) *passim*. (17) *ibid.* 1 (1901-1902) *passim*. (18) *ibid.* 5 (1906) *passim*. (19) J. Fed. Mal. St. Mus. 4 (1909) 1-98. (20) *ibid.* 6 (1915) 127-202. (21) J. Roy. As. Soc. Str. Br. 57 (1911) 5-122. (22) J. Roy. As. Soc. Mal. Br. 4 (1926) 1-121. (23) Agric. Bull. S.S. and F.M.S. 4 (1908) 292-317. (24) *ibid.* 9 (1910) 97-105. (25) J. Roy. As. Soc. Str. Br. 75 (1915) VII-XI. (26) Gard. Bull. 9 (1935) 2-30.

#### 89. Local Peninsular work; Curtis, Low's botanists

The earliest of these local studies was CH. CURTIS's Penang Catalogue (1) of 1894; CURTIS was Ass.-Superintendent of Forests in the Island. At first a traveller for VEITCH & Sons, he explored many parts of the Archipelago, collecting a good many specimens. As Garden Curator at Penang (1884-1902), he greatly added to his collections, and, in

fact, this former forest nursery was turned into a botanical garden 'chiefly from the enthusiasm of CURTIS' (BURKILL *in litt.*). The second local Flora was RIDLEY's own *Flora of Singapore* (cf. § 88), a record of increasing importance as the original plant cover of the island has now practically entirely disappeared. The third is the *Flora of Telom and Batang Padang Valleys*, also from RIDLEY's (cf. § 88), the fourth I. H. BURKILL and M. R. HENDERSON's *The Flowering Plants of Taiping* (2). The Taiping Hills were explored, and the collections preserved in the Perak State Museum, when Sir H. Low held office as a Resident of Perak. He stimulated and directed research e.g. the trips of L. WRAY, who was Curator of the Museum (1883-1908). In 1881, H. KUNSTLER, sent by G. KING (he was one of 'KING's collectors'), had made the first intensive search of the district. Father B. SCORTECHINI was the third explorer who made important discoveries (1882-'86). A list of 'Low's botanists' working in Perak was given by BURKILL and HENDERSON in the opening chapters of their *Taiping Flora*. The *Flora* contains a wealth of plant geographical and ecological data though the species are not described nor keys given.

References: (1) J. Roy. As. Soc. Str. Br. 25 (1894) 67-167. (2) Gard. Bull. 3 (1925) 303-464.

#### 90. Burkill

J. H. BURKILL published in 1918 a history of Singapore Gardens and in 1927 a useful survey of the *botanical collectors, collections, and collecting places in the Peninsula*, graphically illustrating the state of knowledge of the plants in various parts of the country, and he compiled a list which contributes to a clearer understanding of many undetailed labels (1).

BURKILL was Director of Singapore Botanic Gardens from 1912 till 1925, and worked, like his predecessor, in various fields of phytography. I have alluded to his several papers on *Dioscorea* (2, also § 87) but he also wrote extensively on native drugs (3). His *Dictionary of the Economic Products of the Malay Peninsula* (2 vols, 1935), a masterpiece of synthesis, attracts the student in its easy and lucid style, its balanced articles which convey, often in few sentences, the purport of decades of research while supplying a good deal of factual and precise information. Introductory paragraphs to many of the main entries embody a history of the product under discussion and prove not only BURKILL's prolonged study into the history of Malaysian botany but demonstrate his considerable literary talent which enabled him to outline by simple means a complicated course of events and to seize and inspire the reader's imagination. It is to be noted that BURKILL was a former assistant of G. WATT, author of the famed *Dictionary of economic products of India* (1888).

At the moment, BURKILL is preparing a survey of 150 years botanical work in India.

Of the most recent phytography executed in the Malay Peninsula the brief account given in §§ 91-94 may suffice.

References: (1) Gard. Bull. 2 (1918) 55-63; *ibid.* 4 (1927) 69-77; and also p. 113-202. (2) *ibid.* 5 (1930) 51-58. (3) *ibid.* 6 (1931).

#### 91. Corner

E. H. J. CORNER published the majority of his articles in the *Gardens Bulletin* (e.g. the second of his studies (1) in *Ficus*). The series *Notes on the systematy and distribution of Malayan Phanerogams* (2) attracted much attention. His delightful *Wayside Trees of Malaya* (2 vols, 1940) deals with much more than its title suggests. The conception 'wayside tree' is generously interpreted and the book full of close and ingenious ecological observations (e.g. on *Ficus* growth habits, mode of branching in tropical trees etc.); it will remain a preferred and authoritative source of information. CORNER's taste for morphological-ecological research is also apparent in his recent paper on *Centrifugal stamens* (3).

Soon after the English had returned to the Malay Peninsula, CORNER left Singapore (1946) and went to S. America, exchanging the Assistant Directorship of Singapore Gardens for the post of Principal Scientific Field Officer of the Hylean Amazon Project. In 1948 he resigned. Having resumed the study of Malaysian botany, he is at present Lecturer at Cambridge and an active collaborator in the writing of *Flora Malesiana*.

References: (1) Gard. Bull. 10 (1939) 82-161. (2) *ibid.* 10 (1939) 1-55, 56-81, 239-329; *ibid.* 11 (1941) 177-235. (3) Journ. Arn. Arb. 27 (1946) 423-437.

#### 92. Henderson, Symington; descriptive forestry

At Kuala Lumpur, later Singapore, worked M. R. HENDERSON who made detailed, though not unduly long, descriptions of numerous Peninsular species; he adopted early the metric system in his records of measurements.

A number of regional studies on the flora were composed by him, such as *List of plants from Cameron's Highlands* (1), the *Flowering plants of Kuala Lumpur* (2), *Notes on the flora of Pulau Tioman* (3), the 'padang' flora (4), and the *Flora of the Limestone Hills* (5). He supplemented the *Flora of the Malay Peninsula* (6, cf. § 88), and made an extensive monograph of the Malayan species of *Eugenia* (8).

C. F. SYMINGTON's *Forester's Manual of Dipterocarpaceae* was published at Kuala Lumpur in 1943; it was without his knowledge and without his consent. This *Manual* is the result of many years careful and devoted study in the intricate systematics of the *Dipterocarpaceae* on which he had published in the 'Gardens' Bulletin' since 1933 a series of preliminary articles on the subject. SYMINGTON did not live to see his final book in print (his death occurred in 1943).

SYMINGTON's work touches applied systematics in the shape of forestry, which had made since CANTLEY, RIDLEY, and CURTIS great progress in the Peninsula. A. M. BURN-MURDOCH, Conserv-





The Herbarium at Singapore

Photo M. R. Henderson

ator of Forests (1904-'14) published *Trees and Timbers of the Malay Peninsula* (1911-'12). DESCH also wrote on timbers, as did F. W. FOXWORTHY who after his work in the Philippines, had moved to the Federated Malay States in 1918 (*cf.* § 83). He published in 1921 *Commercial Woods*, and in 1922 and 1927 *Minor Forest Products of the Malay Peninsula*. *Dipterocarpaceae* were also preferably studied by FOXWORTHY. All these studies were issued as *Malayan Forest Records* of which 16 appeared between 1921 and 1943, published by the Forest Research Institute (Kepong).

*References:* J. Roy. As. Soc. Mal. Br. 5 (1927) 237-277. (2) Gard. Bull. 4 (1928) 211-373. (3) *ibid.* 5 (1930) 80-93. (4) *ibid.* 5 (1931) 234-240. (5) J. Roy. As. Soc. Mal. Br. 17 (1939) 13-87. (6) Gard. Bull. 7 (1933) 87-128. (8) *ibid.* 13 (1949) 1-293, also *ibid.* 11 (1947) 299-338.

#### 93. *Holtum*

R. E. HOLTUM, the present Director of Singapore Gardens, worked in various fields of phytography. He brought the rather disturbing proof that Orchids may hybridize and produce 'species' which had hitherto never been suspected to be of hybrid origin (1). His numerous articles on Pteridophytes (2) and his chapter on the ecology of tropical Pteridophytes in VERDOORN'S *Manual of Pteridology* (1938) led to a *Fern Flora of the Malay Peninsula* (1942-'44) which was not published but furnished the materials for his *Revised classification of Lepidoporiaceae Ferns* (3). Dozens of new species of

Phanerogams were described at irregular intervals, especially Monocotyledons (4). He contributed to the phytography of Mt Kinabalu (5), studied Malayan bamboos (6), and did research in the comparative morphology of *Cyperaceae* (7); there are several other publications (8).

HOLTUM, in collaboration with BURKILL, investigated the flora of Fraser Hill; the outcome was a history of the 'warmth and moisture loving flora of the Malay Archipelago from the Miocene period' (8).

*References:* (1) Bull. Jard. Bot. Btzig III, 16 (1939) 113-115. (2) Gard. Bull. 4-9 (1926-1938) *passim*; Mal. Nat. Journ. 3 (1948) 1-9. (3) J. Linn. Soc. Bot. 53 (1947) 123-158. (4) Gard. Bull. 11 (1947) 267-298. (5) *ibid.* 7 (1934) 191-324. (6) J. Arn. Arb. 27 (1946) 340-346. (7) Bot. Rev. 14 (1948) 525-541. (8) Gard. Bull. 3 (1923) 19-111; *ibid.* 4 (1927) 92-105. (8). *ibid.* 5 (1931) 173-206.

#### 94. *Periodicals; some other authors*

The study and interpretation of the International Rules of Botanical Nomenclature at Singapore fell in particular to C. X. FURTADO who, representing the formalist and strict school, published several papers on the subject (1). Apart from these applied theoretics, he wrote a considerable series of articles on the systematics of Malaysian *Palmae* (2) and *Araceae* (3).

C. E. CARR specialized in the phytography of Malayan Orchids since 1929. He wrote a paper on a collection of Orchids from Brastagi, N. Sumatra



(4). Of later years, he assembled vast collections in the Mal. Peninsula, in Borneo (Mt Kinabalu, §102), and in British New Guinea; he died there, still young, at Port Moresby in 1936. He was a man of considerable promise.

The 6th volume of the *Gardens' Bulletin* (1931) was entirely devoted to vegetable native medicines of the Malay Peninsula; extensive studies were contributed by BURKILL (*cf.* § 90), J. D. GIMLETTE, M. HANIFF, and D. HOOPER.

The main periodicals appearing in the Peninsula have been referred to (§§ 88, 92); it is to be noted that the 'Journal of the Straits Branch of the Royal Asiatic Society' changed its name to 'Journal of the Malayan Branch *etc.*' in 1923. An Index to the 86 volumes of the 'Journal of the Straits Branch' appeared in volume 5 of the 'Malayan' series.

In addition are to be included the 'M.A.H.A.' or 'Magazine of the Malayan Agri-Horticultural Association' (at Kuala Lumpur, since 1933), the 'Malayan Orchid Review' (since 1932), and the 'Malayan Nature Journal' (since 1945). The 'Singapore Natural History Society' (1921) published 'The Singapore Naturalist' which remained less noticed than the journal of its sister society in Java (*cf.* § 100).

*References:* (1) *e.g.* Bull. Jard. Bot. Botz III, 16 (1939) 116–119; Gard. Bull. 10 (1939) 162–181. (2) *ibid.* 8–11 (1933–1941) *passim*. (3) *ibid.* 8–11 (1933–1941) *passim*. (4) *ibid.* 5 (1929) 1–50, 124–160; *ibid.* 7–8 (1930–1934) *passim*; Journ. Roy. As. Soc. Mal. Br. 11 (1933) 66–109.

C. INDONESIA

95. *Phytography at Buitenzorg, 1910–1918*

J. C. KONINGSBERGER succeeded TREUB as Director of the Buitenzorg Botanic Gardens (1910–'18). KONINGSBERGER, though a professional zoologist, supported vigorously the research into the Javan flora as had been planned and then was in progress. He was instrumental in the establishment of a Nature Reserve and botanical garden at Sibolangit (NE. Sumatra) on the lower slope of Mt Sibajak in 1914, which gave J. A. LÖRZING the opportunity to assemble an exemplary collection of indigenous specimens accompanied by extensive and most informative notes. LÖRZING wrote some good popular papers himself. The uncertain fate of Sibolangit Garden—deliberate Governmental neglect was never decisively conquered by the Buitenzorg Staff—is more or less comparable to that of the Penang Garden; Sibolangit yielded decidedly lesser results than Penang while it might have been a match, had circumstances permitted.

The outbreak of World War I greatly hampered contacts with Europe and impeded not only phytography in Malaysia generally but it even appeared in 1918 that two systematists, H. J. LAM and R. C. BAKHUIZEN VAN DEN BRINK *Sr* had unknowingly elaborated the same family, the *Verbenaceae* (1). Eventually, a second revision (2) appeared by joint authorship (1921, *cf.* § 99). The work of VALETON, KOORDERS and others has been discussed pre-

viously (§§ 69, 72, 73); for J. J. SMITH and C. A. BACKER see § 96 and § 100.

A concise, not highly successful, *Zakflora voor de Landbouwstreken op Java* by I. BOLDINGH appeared in 1916.

There were published, in these years, a stream of studies, either executed at Buitenzorg or based on materials acquired through the intermediary of the Buitenzorg Gardens. Phytography was only incidentally and indirectly served by them; the titles referred to here might be seen as a small selection.

A. ERNST and CH. BERNARD wrote morphological-biological studies on Javan saprophytes (3). ERNST published in later years numerous papers, usually cytological or biological on the data assembled during his extensive travels in the Archipelago. BERNARD did mainly work on phytopathology (*Fungi*).

F. C. VON FABER described *Coffea* (4), mangrove (5), and the crater vegetation (6); he elaborated the 2nd edition (1935) of SCHIMPER's *Pflanzengeography* (§ 76).

W. M. DOCTERS VAN LEEUWEN (*cf.* § 97) investigated *Angiopteris evecta* (7) and, together with Mrs J. DOCTERS VAN LEEUWEN-REYNVAAN wrote on *Dischidia* (8); with H. H. KARNY they published *Beiträge zur Kenntniss der Gallen von Java* (9).

P. GUÉRIN and G. BREMER, both in 1916, published the *Reliquiae Treubianae* (10). J. C. COSTERUS worked on the morphology of *Zingiberaceae* and *Marantaceae* (11) and besides studied Malaysian teratology as a whole.

*References:* (1) LAM, The *Verbenaceae* of the Malayan Archipelago (1919). (2) Bull. Jard. Bot. Botz III, 3 (1921) 1–116. (3) Ann. Jard. Bot. Botz (1910–1914) *passim*. (4) *ibid.* 25 (1912) 59–160. (5) Ber. Deut. Bot. Ges. 31 (1913); *ibid.* 41 (1923). (6) VON FABER, Die Kraterpflanzen Javas (1927). (7) Ann. Jard. Bot. Botz 25 (1912) 202. (8) Ann. Jard. Bot. Botz 27 (1913) 65, also Trop. Natuur 2 (1913). (9) Bull. Jard. Bot. Botz II, 10 (1913). (10) Ann. Jard. Bot. Botz 29 (1916). (11) *Dodonaea* 6 (1894) 24–41; Ann. Jard. Bot. Botz 15 (1898) 40–42; with J. J. SMITH *cf. ibid.* 13, 19, 23, 24, 28, 29, 32, 33, 39, 42 (1895–1931) *passim*.

96. *J. J. Smith*

J. J. SMITH shared the good fortune of some of his contemporaries; he lived to a high age (1867–1947) and published his phytographical papers in the course of more than half a century. This implies that the period of his activities began during TREUB's early years, continued through two World Wars and ended only recently. Rather arbitrarily, I have chosen to place a reference to his work here, more or less in accordance with the time of his holding the post of Head of the Buitenzorg Herbarium (1913–1924).

Born at Antwerp of Dutch parents, he came to the Gardens in 1891, and became Assistant Curator in 1893. Orchids became his lifelong cherished study but when he retired in 1924 he had also done remarkably good work in *Ericaceae* (1) and *Euphorbiaceae* (2); for the latter his basis was J. MUELLER's

classic monograph. He published papers on some other, smaller families (3). SMITH went only on one large excursion; the unfortunate voyage to Ambon in 1900 with BOERLAGE in quest of Rumphian plants. BOERLAGE died and SMITH returned alone, himself seriously ill. After this, he confined his field work to some short trips in W. Java (*cf.* also § 21).

As regards Orchids, special mention is to be made of his numerous contributions to 'Icones Bogorenses' (4), and his series of 16 articles on *Orchidaceae novae malayenses* (5).

He enumerated the Orchids of Sumatra (6) and described in particular those of Java (7), Borneo (8), Celebes (9), Amboina (10), Ceram (11), the N. Moluccas (12), Talaud (13), Anambas and Natona Isl. (14), and New Guinea (15). L. J. TOXOPEUS's Boeroe collections (1921, published 1928) gave SMITH an opportunity (16) to demonstrate the intermediate position of the Moluccan Orchid flora between those of the Philippines and New Guinea. He composed a key to the genera of Malaysian Orchids (17).

SMITH ranks, with R. SCHLECHTER (New Guinea) and O. AMES (Philippines), among the leading orchidologists of the first half of the 20th century. He was essentially a 'pure' phytophrapher, first of all seeking to describe his specimens with the greatest possible accuracy, with a love of detail. His scientific interest developed in a direction contrary to that observed in the majority of systematists: instead of starting with the study of small *taxa* and gradually applying and adding his results in the investigation of increasingly larger groups, or even of the system as a whole, SMITH limited his interest more and more to Orchids exclusively. Gradually he tried less to define species possibly because he preferred specimen-description at this stage of Malaysian Orchidology but certainly also because he was forced to found his species on single specimens, no other materials having been collected. Though the extent of his work on Malaysian Orchids surpasses by far any other study in this department, he never attempted a complete survey. Was it a premonition that the Malaysian *Orchidaceae* would prove to hybridize in a wild state to such a degree as can only be guessed at the moment and that a satisfactory species-delimitation, from a genetical point of view, will have to rely on future experimental research? This is as may be, SMITH left besides his thousands of patiently composed descriptions, his *Icones Orchidacearum Malayensium* a series of pen drawings at which he laboured till his last day (18).

He was one of the best contributors to 'De Orchidee' and to 'Orchideeën', the journal of the Netherlands Orchid Society. Similar periodicals devoted to Orchidology appeared in the Philippines (*cf.* § 85) and in the Malay Peninsula (*cf.* § 94).

SMITH is the author of an *Illustrated Guide to the Botanic Gardens, Buitenzorg* (1910, next year a Dutch version, second edition 1924), and composed a list of publications by Buitenzorg officials covering 25 years (§ 72). A special issue of 'Blumea'

commemorated at his 70th birthday in 1937 his life and work; a bibliography was included.

*References:* (1) Ic. Bog. 4 (1910–1912) *passim*; Med. Dept Landb. 18 (1914); Nova Guinea 12 (1914) 129–168; Med. Rijksherb. Leiden 25 (1915), 30 (1916); Nova Guinea 12 (1917) 495–537; Fedde Rep. 30 (1931) 162–178; *ibid.* 35 (1934) 292–297; Contr. Arn. Arb. 8 (1934) 122–129; Nova Guinea 18 (1936) 89–121. (2) Med. Dept Landb. 10 (1910); Nova Guinea 8 (1912) 779–796; *ibid.* 12 (1917) 543–548. (3) *Moraceae* in Med. Dept Landb. 2 (1906), also in Ic. Bog. 3 (1907) *passim*; *Burmanniaceae* in Ann. Jard. Bot. Btzg 23, 24, 26, 28 (1909, 1911, 1912, 1914) *passim*, also in Nova Guinea 8 (1909) 193–196; *Epacridaceae* in Nova Guinea 8 (1912) 797–803; *ibid.* 18 (1936) 89–121; *Ulmaceae* in Nova Guinea 8 (1912) 891–892. (4) Ic. Bog. 2–4 (1903–1914) *passim*. (5) Bull. Inst. Bot. Btzg 7 (1900) 1–5; Bull. Dép. Agric. Ind. Néerl. 5 (1907) 1–36; *ibid.* 15 (1908) 1–26; *ibid.* 22 (1909) 1–51; *ibid.* 45 (1911) 13–25; Bull. Jard. Bot. Btzg 3 (1912) 53–69; *ibid.* 8 (1912) 38–47; *ibid.* 13 (1914) 1–52; Bull. Jard. Bot. Btzg III, 2 (1920) 15–127; *ibid.* 5 (1922) 12–102; *ibid.* 8 (1926) 35–70; *ibid.* 8 (1927) 138–195; *ibid.* 9 (1928) 25–84; *ibid.* 12 (1932) 105–150; Fedde Rep. 36 (1934) 110–119; Bull. Jard. Bot. Btzg III, 14 (1937) 160–168. (6) Fedde Rep. 32 (1933) 129–386. (7) SMITH, Flore de Buitenzorg, vol. 6 (1905) with 'Figuren Atlas' 1906–1914; Bull. Dép. Agric. Ind. Néerl. 13 (1907) 1–78 (repr. in Fedde Rep. 5 (1908) 289–305); *ibid.* 43 (1910) 1–77; Bull. Jard. Bot. Btzg 9 (1913) 1–130; *ibid.* 14 (1914) 1–56; *ibid.* 26 (1918) 1–135; Bull. Jard. Bot. Btzg III, 3 (1921) 227–333; *ibid.* 9 (1927) 23–66; Fedde Rep. 29 (1931) 248–252; De Orchidee 3 (1934) 312–314 (see also Ic. Bog. and Tafeln Jay. Orch. Bull. Jard. Bot. Btzg III, 3 (1921) 245, tab. 18–37; *ibid.* 6 (1924) 9, tab. 1–25). (8) Bot. Jahrb. 48 (1912) 96–106; Mitt. Inst. allg. Bot. Hamburg 8 (1927) 9–76; Brittonia 1 (1931) 105–111; Bull. Jard. Bot. Btzg III, 11 (1931) 83–160; De Orchidee 4 (1935) 183–184. (9) Nat. Tijds. Ned. Ind. 58 (1898) 358–362; Svensk. Bot. Tidskr. 20 (1926) 470–482; Bull. Jard. Bot. Btzg 10 (1928) 1–24; Engl. Bot. Jahrb. 65 (1933) 449–508; De Orchidee 5 (1936) 154–156. (10) SMITH, Die Orchideen von Ambon (1905) 1–125; Philip. J. Sci. Bot. 12 (1917) 249–262; in MERRILL, Interpr. Rumph. Herb. Amb. (1917) 168–179. (11) Bull. Jard. Bot. Btzg 10 (1928) 85–172. (12) *ibid.* 11 (1930) 67–81. (13) *ibid.* (14) Fedde Rep. 30 (1932) 327–336. (15) Bull. Dép. Agric. Ind. Néerl. 5 (1907) 3–4; *ibid.* 19 (1908) 1–39; Nova Guinea 8 (1909) 1–148; Bull. Dép. Agric. Ind. Néerl. 39 (1910) 1–22; Bull. Jard. Bot. Btzg 2 (1911) 1–20; Nova Guinea 8 (1911) 521–611; Bull. Jard. Bot. Btzg 8 (1912) 70–79; Fedde Rep. 10 (1912) 136–140, 274–280; Nova Guinea 12 (1913) 1–108; Fedde Rep. 11 (1913) 552–560; *ibid.* 12 (1913) 24–34, 110–123, 394–406; Bull. Jard. Bot. Btzg 13 (1914) 53–77; Nova Guinea 12 (1915) 173–272, (1916) 273–477; Meded. Rijksherb. Leiden 23 (1915) 1–21; in GIBBS, A contrib. to . . . Arfak Mts (1917) 105–127, 203–206; Nova Guinea 14 (1929) 337–516; Engl. Bot. Jahrb. 56 (1934) 161–215; Nova Guinea 18 (1935) 9–85. (16) Bull. Jard. Bot.



VAN STEENIS



SYMINGTON



TEYSMANN



THUNBERG

Btżg III, 9 (1928) 439–481. (17) *Blumea* 1 (1934) 194–215. (18) *Bull. Jard. Bot. Btżg III*, Suppl. 2–3 (1930–1941). (19) DE CAND., *Prod.* 15<sup>2</sup> (1866).

97. *The period 1918–1932 at Buitenzorg; Docters van Leeuwen*

W. M. DOCTERS VAN LEEUWEN, successor to KONINGSBERGER as Director at Buitenzorg (1918–1932), stimulated collecting and took an active part himself. He made e.g. an expedition to Salajar (1) in 1913, to Krakatoa (2) in 1919, to New Guinea with the Dutch-American Expedition in 1926; he reported on his observations on the summits of several Central and East Javan volcanoes (3). Being essentially a field biologist, his publications are but rarely purely phytographical; as a rule, they belong chiefly to the ecological and biological provinces of botany. He is a pioneer of E. Asiatic cecidology and wrote together with Mrs J. DOCTERS VAN LEEUWEN-REYNVAAN *The zoocecidia of the Netherlands East Indies* (1926, supplemented (4) in 1941).

He wrote a large and instructive study on plants and animals and their relations in the upper parts of Mt Pangrango-Gedeh, the result of observations and research on often repeated trips to the region (5). He continued the investigation of the new Krakatoa flora; his book on the Krakatoa archipelago, which summarized the data obtained from 1883 to 1933, augmented by personally assembled materials, appeared as a volume of the 'Annales' (1936) and is a standard work on the subject. It contains an important bibliography.

He is the author of some hundreds of smaller papers on various fields of botany or biology. I have referred to some previously (§ 95) but wish to add a few more titles because DOCTERS VAN LEEUWEN's papers contain now and then detailed phytographical sections and, as these were added in order to discuss or demonstrate functions of the plant in relation to animals, sometimes descriptions of characteristics or organs are given not usually found in systematic literature. There are his papers on epiphytes dispersed by ants (6), on the early growth stages of *Loranthaceae* (7), and on flowers visited by birds (8).

Under DOCTERS VAN LEEUWEN's term of office

the Botanic Gardens at Buitenzorg were the source many valuable phytographical studies (cf. §§ 98 and 99).

H. A. B. BÜNNEMEIJER did most of his collecting (1916–'24) under DOCTERS VAN LEEUWEN's direction. BÜNNEMEIJER explored little known regions of Sumatra, Banka, Billiton, Riouw, and S. Celebes as a professional collector of the Herbarium and made fine collections. He wrote some small popular accounts (9).

Important publications on economic plants also appeared in this period which are mentioned later (cf. §§ 99, 100, 109); the latest Catalogue of "s Lands Plantentuin" by P. M. W. DAKKUS appeared in 1930 containing c. 10,000 names of species under cultivation (10) and was supplemented in 1938 by an Index to the genera. DAKKUS wrote a popular book on Orchids (1), and some popular notes of his experiences on the expedition (1924–1925) with HANS WINKLER into Central Borneo (12).

*References:* (1) *Blumea* 2 (1937) 239–277. (2) *Hand. 1e Ned. Ind. Nat. Wet. Congr.* (1919) 36–79. (3) *Ber. Deut. Bot. Ges.* 31 (1913) 151–157; *Nat. Tijd. Ned. Ind.* 85 (1925) 23–48; *Bull. Jard. Bot. Btżg III*, 11 (1930) 28–56; *Gedenkboek J. P. Thijssse* (1935) 57–62. (4) *Ned. Kruidk. Arch.* 51 (1941) 122–251. (5) *Verh. Kon. Akad. Wet. Afd. Nat.* 31 (1933) 1–278. (6) *Trop. Natuur* 18 (1929) 57–65, 131–139; *Ber. Deut. Bot. Ges.* 46 (1929) 90. (7) *Versl. Verg. Wis. & Nat. Afd. Kon. Akad. Wet.* 23 (1915) 1438–1449; *Trop. Natuur* 20 (1931) 103–118; *ibid.* 25 (1936) 24–27. (8) *Ann. Jard. Bot. Btżg* 42 (1931) 1–39; *ibid.* 48 (1938) 27–68. (9) *Trop. Natuur* 7–10 (1918–1921) *passim*. (10) *Bull. Jard. Bot. Btżg III*, suppl. 1 (1930) 1–305, Index (1938). (11) DAKKUS, *Orchideeën in Nederl. Indië* (3rd ed. 1935). (12) *Ind. Comité Wet. Ond.* (1925) 1–16; also *Trop. Natuur* 14 (1925) 129–139.

98. *The 'Contributions à l'étude &c.'*

During DOCTERS VAN LEEUWEN's Directorship, the plans for a Flora of the Netherlands East Indies came to an issue. In the 'Bulletin' of the Buitenzorg Gardens appeared from 1923 till 1941 a series of 34 *Contributions à l'étude de la Flore des Indes néerlandaises*. On page vii of this volume, DR VAN STEENIS has pointed out what prevented these con-

tributions to represent ultimately a satisfactory 'Flora Malesiana', or at least a Flora of Indonesia.

The following families and genera were treated:

- Bignoniaceae* (No 16, VAN STEENIS, 1929)
- Boerlagellaceae* (No 5, LAM, 1925)
- Bombacaceae* (No 4, BAKHUIZEN *Sr*, 1924)
- Buddleiaceae* (No 1, CAMMERLOHER, 1923)
- Burseraceae* (No 22, LAM, 1932)
- Ceratophyllaceae* (No 25, VAN STEENIS, 1933)
- Cochlospermaceae* (No 29, VAN STEENIS, 1936)
- Combretaceae* (No 2, VAN SLOOTEN, 1924)
- Corynocarpaceae* (No 24, VAN STEENIS, 1933)
- Dipterocarpaceae*
  - Anisoptera* (No 8, VAN SLOOTEN, 1926)
  - Cotylelobium* (No 18, VAN SLOOTEN, 1929)
  - Dipterocarpus* (No 11, VAN SLOOTEN, 1927)
  - Dryobalanops* (No 20, VAN SLOOTEN, 1932)
  - Parashorea* (No 12, VAN SLOOTEN, 1927)
  - Vatica* (No 14, VAN SLOOTEN, 1927)
- Droseraceae* (No 27, VAN STEENIS, 1933)
- Ebenaceae* (No 33, BAKHUIZEN *Sr*, 1936-'41)
- Flacourtiaceae* (No 6, VAN SLOOTEN, 1925)
- Lauraceae*
  - Cinnamomum* (No 7, CAMMERLOHER, 1925)
- Loganiaceae* (No 1, CAMMERLOHER, 1923)
- Loranthaceae* (No 19, DANSER, 1931)
- Nepenthaceae* (No 15, DANSER, 1928)
- Orobanchaceae* (No 23, BAKHUIZEN *Sr*, 1933)
- Philydraceae* (No 28, SKOTTSBERG, 1933)
- Podostemaceae* (No 30, VAN STEENIS, 1936)
- Polygonaceae* (No 10, DANSER, 1927)
- Rubiaceae*
  - Ixora* (No 34, BREMEKAMP, 1937, '40)
  - Wendlandia* (No 31, COWAN, 1936)
- Sapotaceae* (No 5 & 13, LAM, 1925, '27)
- Sarcospermaceae* (No 5 & 9, LAM, 1925, '26)
- Stylidiaceae* (No 3 & 32 (err. 31), v. SLOOTEN, 1924)
- Styracaceae* (No 21, VAN STEENIS, 1932)
- Xyridaceae* (No 17, MALME, 1929)
- Zygophyllaceae* (No 26, VAN STEENIS, 1933).

#### 99. The main authors of the 'Contributions'

R. C. BAKHUIZEN VAN DEN BRINK *Sr* was born in 1881. Originally a planter and amateur orchidologist, his collections and devotion to botany drew the attention of professional botanists. From 1917 till 1935, when he retired from official service, he worked in the Buitenzorg Herbarium. In later years, he collaborated voluntarily until his imprisonment and death during the Japanese occupation of Java (1).

His largest phytophagical studies are in *Bombacaceae* (2) and in *Ebenaceae* (3). He wished his work to be as perfect as humanly possible and made, to this purpose, long and conscientious studies of all available literature. This awakened in him an interest in the history of plants, and he discussed the species represented (4) in the reliefs of Borobudur (cf. § 2), and early American plant immigrants (5).

A series of papers on wild vegetables appeared from 1922-'24 in 'De Tropische Natuur'. These proved him eligible to write the descriptive para-

graphs of J. J. OCHSE's *Indische Groenten*, appearing in 1931. The same authors published *Vruchten en Vruchtenteelt in Nederlandsch-Oost-Indië* in that year.

Both books appeared in an English translation in the same year (*Vegetables in the Dutch East Indies and Fruits and Fruit-culture in the Dutch East Indies*).

BAKHUIZEN concentrated, in his trips, on West Java and, together with W. F. WINCKEL, or with his son and namesake, collected a large herbarium and discovered not infrequently botanical rarities. He indicated Tjadasmalang (S of Tjiandjoer) as a rich field for exploration, succeeded in obtaining protective measures for the area, and searched it thoroughly. Although the majority of his publications deals with the whole of the former Netherlands Indies, he added much to the collections of the West Javan flora. To his work in *Verbenaceae* has been referred above (§ 95).

B. H. DANSER stayed at Buitenzorg from 1925-'29. Returning to the Netherlands, he accepted a post in the University at Groningen where he succeeded J. C. SCHOUTE, in 1931, as Professor Extraordinarius, and was appointed Professor in 1943. In the same year he died.

DANSER was particularly attracted to the genetic aspects of systematics though his larger publications are taxonomical. In the Netherlands, he cultivated, crossed, and experimented with many species of *Polygonum* and *Rumex*, and described his results (6); in Java he treated species of *Stachytarpheta* in the same manner. He wrote on the species concept in botany and threw new light on species delimitation (7) by his theories (*comparium, commiscuum, and convivium*).

His extensive research into European *Polygonaceae* (1915-'26) found a natural issue in *Die Polygonaceae Niederländisch Ost-Indiens* (8) and various other studies on Malaysian *Polygonaceae* (9). His Malaysian studies were, chiefly, *The Nepenthaceae of the Netherlands Indies* (10), *The Loranthaceae of the Netherlands Indies* (11), a *Revision of the Philippine Loranthaceae* (12), and some papers on *Stachytarpheta* (13), *Cornaceae* (14), and *Santalaceae* (15). He proposed a new taxonomical arrangement of *Loranthaceae-Loranthoideae* (16) and wrote a considerable study of SE. Asiatic species of *Korthalsella* (17). He had undertaken to elaborate a part of the Malaysian Conifers for *Flora Malesiana* but the Pacific War and his early death prevented this. His biographers said: (transl.) 'his strictly scientific manner of discussion and his lively style made his publications often a pleasure to read'. Malaysian phytophagy lost in him, it is believed by many, its ablest worker.

D. F. VAN SLOOTEN, since 1931 Head of the Buitenzorg Herbarium, submitted as his doctor's thesis a revision of the *Combretaceae* and *Flacourtiaceae* of the Netherlands Indies (18). He went to Java (1919) where he remained till the present day. He is the author of ten of the *Contributions à l'étude etc.* (cf. § 98). Since 1926, he has been absorbed in the study of *Dipterocarpaceae*, a large family of forest trees of foremost importance and complicated systematics.

Recently, his results were laid down in *Sertulum Dipterocarpacearum Malayensium*, of which 4 instalments have appeared (19).

Together with C. A. BACKER, he wrote *Geillustreerd Handboek der Javaansche Theeonkruiden* (1924), a work containing 240 good plant portraits of weeds in tea plantations. An evaluation of ZOLLINGER's botanical research (20) appeared in 1929; he published several articles connected with the history of the Buitenzorg Gardens (TEYSMANN (21), Herbarium (22)).

From 1919-'34 he was one of the main editors of 'De Tropische Natuur', which gained a reputation as one of the finest and most valuable popular biological periodicals appearing anywhere in the tropics.

H. J. LAM arrived in 1919 in Java, at the same time as VAN SLOOTEN. In 1920, he collected on an expedition to the Mamberamo region and the Wilhelm Mountains in New Guinea; in 1926 he explored the Talaud Archipelago and, on both occasions, secured many new species. He remained till 1933 at Buitenzorg and returned to the Netherlands to occupy the Chair of Botany at Leyden, and as Director of the Rijksherbarium.

LAM wrote on many subjects. His main contributions to Malaysian phytography have dealt with the *Verbenaceae* (Dr's thesis, cf. § 95), *Boerlagellaceae*, *Sarcospermaceae*, *Sapotaceae*, and *Burseraceae*. These families formed the subject of revisions (cf. § 98); as a rule the *taxa* were not only described but their distribution was considered in connexion with plant geography. LAM published lively narratives of his travels. I mention those of his observations in New Guinea (23, cf. also § 106), on Mt Slamet (24), on Mt Jareme (25), the Minahassa (N. Celebes, (26), cf. also § 103), and on Mianghas (27).

A first study in plant geography in relation to WEGENER's theory was written in 1930 (28); an important morphological study is e.g. that on *Burseraceae* (29).

Useful surveys appeared in *Science in the Netherlands East Indies* (1929) which included a list of institutions of pure and applied science augmented by a summary of periodicals and, in 1948, a report of the botanical work done in the Netherlands and pertaining to the East Indies (1918-1943).

Phylogenetic problems have drawn LAM's attention during many years. A recent essay is *Classification and the new morphology* (30).

Under LAM's directorship, Leyden resumed its position as a leading institution for Malaysian phytography. Many articles in *Blumea*, the journal of the Rijksherbarium, in 1934 founded and since edited by LAM, testify of this reborn interest; the *Flora Malesiana* enjoys his vigorous support.

C. G. G. J. VAN STEENIS was appointed in 1927 in the Buitenzorg Herbarium. In the next year, he made a trip to the Anambas and Natuna Archipelago, partly together with HENDERSON (§ 92). In 1929, he explored the Ranau region in S. Sumatra, in 1936 Bali, in 1937 he penetrated into the Alas and Gajolands in N. Sumatra. He collected extensively and, by numerous smaller excursions in Java (preferably to investigate the mountain flora) add-

ed considerably both to the knowledge of the flora and to the plant geography of Java. Moreover, he studied the ecology, distribution, and biology of numerous species.

Dozens of papers contain the results of his trips (31). His main works, so far, are the 3 parts of *On the origin of the Malaysian mountain-flora* (32) and *Maleische Vegetatieschetsen* (33). These put the plant geography of Malaysia partly on new and, as a whole, on immeasurably firmer foundations than before (34). Of several handbooks, now in course of publication, volumes 1-3, and the present volume of this Flora may be consulted.

VAN STEENIS's many articles in 'De Tropische Natuur' are mainly devoted to ecological and systematic studies (35). In 1932, he published a descriptive account of the pteridophytes and phanerogams of the Deutsche Limnologische Sunda-Expedition (36). He wrote a doctor's thesis on *Bignoniaceae* (37) and afterwards elaborated a number of smaller families (see preceding paragraph) and genera (*Brugmansia* (38), *Arisaema* (39), *Sophora* (40), *Lonicera* (41), etc.). A series of *Miscellaneous botanical notes* is in progress (42). The finest collection of annotated coloured plates ever made, depicting the Javan mountain flora, and also a series of photographs with text, remain unpublished for lack of funds.

VAN STEENIS left Java in 1946, having protected the collections in the Herbarium and the Botanic Gardens against irreparable damage by his timely presence and untiring activity in the unruly months at the close of 1945 and first half of 1946.

He was appointed as general editor of *Flora Malesiana* and in that capacity also edits the 'Flora Malesiana Bulletin'. He continues co-editing the 'Bulletin of the Botanic Gardens, Buitenzorg'.

VAN STEENIS is the editor and co-author of the new *Schoolflora of Java* which has been published recently.

C. E. B. BREMEKAMP's work is finally to be considered among that of the authors of the *Contributions*. Originally a plant physiologist, BREMEKAMP later directed his interest to taxonomy. After some years of work at the Sugar Experiment Station at Pasoeroean and in South Africa, he returned to the Netherlands where he continued his taxonomical research at Utrecht. Although he did not limit his studies to Malaysia, he demonstrated a definite preference for our region and specialized in *Rubiaceae* (43) and *Acanthaceae* (44), writing many large or small papers on groups in these families.

He showed himself not satisfied with a close well-built species description but added detailed discussions of previous literature and of the reasons moving him when adopting a different view. Constantly he tested and tried to improve the taxonomical arrangement so far adhered to. In his papers an uncommonly high percentage of new species is proposed, owing to his conviction that specific limits may be drawn narrow, and that in case of an aberrant specimen a provisional distinction and assignment of a binomium are preferable to postponement of study and ultimate conclusion until more data will come to hand.

*References:* (1) Bull. Bot. Gard. Btzg III, 18 (1949) 1-4. (2) *ibid.* III, 6 (1924) 161-255. (3) Gard. Bull. 7 (1933) 161-189; J. Arn. Arb. 16 (1935) 68-75; Bull. Jard. Bot. Btzg III, 15 (1936) 1-49, (1937) 49-178, (1938) 177-368, (1941) 369-515. (4) Trop. Natuur 10 (1931) 181-186. (5) Nat. Tijds. Ned. Ind. 93 (1933) 20-55. (6) Ned. Kruidk. Arch. (1917, 1921-1926) *passim*; Rec. trav. bot. néerl. 18 (1921) 125-212; *ibid.* 19 (1922) 293-308; Genetica 6 (1924) 145-220. (7) Hand. 4e Ned. Ind. Nat. Wet. Congr. (1927) 341-349; Ann. Jard. Bot. Btzg 40 (1929) 1-44; Genetica 11 (1929) 399-450; Hand. 25e Ned. Nat. Gen. Congr. (1935) 1-3. (8) Bull. Jard. Bot. Btzg III, 8 (1927) 117-261. (9) Trop. Natuur 16 (1927) 28-35; Nova Guinea 14 (1927) 333-336; Bull. Jard. Bot. Btzg III, 12 (1932) 65-70; *ibid.* 13 (1935) 429-431. (10) *ibid.* III, 9 (1928) 249-438; *ibid.* 13 (1935) 465-469; also Trop. Natuur 16 (1927) 197-205, and Mitt. Inst. allg. Bot. Hamburg 7 (1931) 217-221. (11) Bull. Jard. Bot. Btzg III, 11 (1931) 233-519; *ibid.* 13 (1935) 487-496; *ibid.* 14 (1936) 73-98, 115-159; *cf.* also *ibid.* III, 10 (1929) 291-373; Rec. trav. bot. néerl. 31 (1934) 223-236, 237-247, 751-760; Blumea 2 (1936) 34-59; *ibid.* 3 (1938) 34-59; *ibid.* 3 (1940) 389-404; *ibid.* 4 (1941) 259-260. (12) Philip. J. Sci. 58 (1935) 151 pp. (13) Ann. Jard. Bot. Btzg 40 (1929) 1-44. (14) Blumea 1 (1934) 46-74. (15) Blumea 3 (1939) 212-235; Nova Guinea, new ser. 4 (1940) 133-149. (16) Verh. Kon. Akad. Wet. sect. 2, 29 (1933) 128 pp. (17) Blumea 4 (1941) 261-319. (18) VAN SLOOTEN, Bijdrage tot de kennis der Combretaceëen en Flacourtiaceëen van Ned. Ind. (1919). (19) Bull. Jard. Bot. Btzg 16 (1940) 430-454; *ibid.* 17 (1941) 96-138, 220-255. (20) Mitt. Gr. Nied. Ind. Neue Helv. Ges. 8<sup>2</sup> (1929) 15-22. (21) Nat. Tijds. Ned. Ind. 91 (1931) 27-49. (22) Vakblad v. Biol. 14 (1933) 161-174; Buitenzorg Post, June 28th, 1937. (23) Teysmannia 32 (1921) 289-326; Trop. Natuur 11 (1922) 38-45. (24) *ibid.* 13 (1924) 17-25. (25) *ibid.* 14 (1925) 2-10. (26) *ibid.* 20 (1931) 209-219. (27) Inter-Ocean 4 (1928) 195-201; Ind. Comité Wet. Onderz. 6 (1928). (28) Tijds. Ned. Aardr. Gen. 47 (1930) 553-581. (29) Ann. Jard. Bot. Btzg 42 (1931-1932) 23-32, 35-158. (30) Acta Biotheoretica 8<sup>4</sup> (1948) 107-154; Blumea 3 (1938) 114-158; *ibid.* 6 (1948) 282-289. (31) *e.g.* Trop. Natuur 20-29 (1931-1940) *passim*. (32) Bull. Jard. Bot. Btzg III, 13 (1934-1935) 23-28, 358-407; *ibid.* 14 (1936) 56-72. (33) Tijds. Kon. Ned. Aardr. Gen. 52 (1935) 25-67, 171-263, 363-398. (34) *ibid.* 65 (1948) 193-207. (35) Trop. Natuur 20-30 (1931-1941) *passim*. (36) Arch. Hydrobiol. suppl. 8 (1932). (37) Rec. trav. bot. néerl. 24 (1927) 787-1049. (38) Trop. Natuur 30 (1941) 33-38. (39) Bull. Bot. Gard. Btzg III, 17 (1948) 447-456. (40) *ibid.* 421-428. (41) J. Arn. Arb. 27 (1946) 442-452. (42) Bull. Bot. Gard. Btzg III, 17 (1948) 383-411; Blumea 6 (1948) 243-263. (43) Bull. Jard. Bot. Btzg 14 (1937) 197-367; also *ibid.* 17 (1940) 276-299; J. Arn. Arb. 21 (1940) 25-31, 32-47; *ibid.* 28 (1947) 145-206; *ibid.* p. 261-308; Fedde Rep. 47 (1939) 12-28; Rec. trav. bot. néerl. 36 (1939) 367-371; *ibid.* 37 (1940) 198-236, 237-378; (44) *ibid.* 35 (1938) 130-176; Boissiera 7 (1943) 182-201; Bot. Jahrb. 73 (1943) 126-

150; Verh. Ned. Akad. Wet. sect. 2, 41 (1944) 12-16, 30; Verh. Kon. Akad. Wet. sect. 2, 45 (1948) 1-39, 1-78.

#### 100. *Recent phytography in Java; Backer c.s.*

In the preceding pages, repeated reference has been made to recent Javan phytography (*cf.* §§ 65-77), but so far C. A. BACKER's publications have been passed nearly unmentioned. Nevertheless, BACKER is a leader of phytography, and the recognized authority on the taxonomy of the Java flora.

Born in 1874, he went to Java and, being a schoolmaster at Batavia, met TREUB at Buitenzorg (1902). His intimate knowledge of plants induced TREUB to try to secure his talents for the Gardens; as regards his collections, these had grown to such dimensions that, when TREUB asked him to come again to Buitenzorg and bring his herbarium, BACKER asked, half jokingly, if TREUB were willing to pay for the railway truck required for its transport.

In 1905, BACKER was appointed in the Herbarium and charged with writing a *Flora of Batavia* (another of TREUB's local Floras!) which appeared in 1907. It was a first volume of some selected families of Dicotyledons in which c. 250 species were closely described; the whole was planned in 6 volumes but only this first reached the printer. It was then preferred to have, first of all a simplified Flora of Java to be used in schools and comprising the more common wild or cultivated Javan plants. This resulted in 1908 in the *Voorlooper eener Schoolflora voor Java*, followed in 1911 by a *Schoolflora voor Java*. This latter book has remained in use till the present day though it deals only with a limited number of Choripetalous families.

BACKER was officially appointed as 'Botanist for the Java Flora' in 1912. In those years, this restless worker acquired an additional knowledge of modern and ancient languages which made his colleagues often, perhaps more often than ought to have happened, apply for his assistance. BACKER never refused to join forces but put aside his own work to give preference to the interests of others, and so there is scarcely any phyto-graphical work of importance published in the period in Java, which has not benefited from BACKER's support (both OCHSE's books on fruits and vegetables (§ 99), HEYNE's encyclopedical work on economic plants, generally, and in particular the *Gramineae*; (§ 109), JESWIET's studies on the systematics of sugar cane (§ 109), *etc.*).

In 1924, BACKER left the Herbarium to be employed as a botanist in the Experiment Station of the Java Sugar Industry at Pasuruan. His services were required; BACKER had demonstrated that indications regarding suitable localities for planting sugar cane, might be derived from the natural composition of the plant cover of the region. BACKER had made (with D. F. VAN SLOOTEN) a study of the weeds of the tea plantations (*see* § 99) and was now entrusted with the composition of a weed flora of the cane fields. When he retired in



1931, this great work had been completely published (1928-'34). About 750 species, mainly herbs, are described in detail but their characteristics are duly stressed. An excellent *Atlas* illustrates this *Onkruidflora der Javasche suikerrietgronden*. In 1941, 15 fascicles of this *Atlas* had been issued; it is doubtful if publication will be resumed.

Of a *Handboek voor de Flora van Java* appeared 3 instalments (1924-'28); these cover the majority of the Monocotyledons of Java.

The problem of Krakatau's new vegetation was studied chiefly from a critical point of view (1).

With O. POSTHUMUS, he wrote the illustrated *Varenflora voor Java* (1939), the first complete, and greatly improved, treatment after RACIBORKI's (cf. § 71), describing 515 species and provided with keys, reference to literature, and ecological discussions.

BACKER is one of the main founders of the 'Nederlandsch-Indische Natuurhistorische Vereniging' (1911) and of its journal 'De Tropische Natuur' (first volume in 1912). His articles in that, and in some other periodicals, deal with a variety of botanical problems and always excel in their phytophraphy. I select from his publications that on naturalized plants in Java (2), on plants of the wet rice-fields (3), on Javan pasture grasses (4), on his search for Bantam plants (5), on *Clerodendron* (6), *Thunbergia* (7), on plants of the dunes (8), *Aristolochiaceae* (9), *Amorphophallus* (10), and on KUNTZE's types of Javan species (11).

In 1931, BACKER returned to the Netherlands. Five years later, 1936, appeared his *Verklarend Handwoordenboek*, a dictionary of the scientific names of wild or cultivated phanerogams and ferns of the Netherlands East Indies and the Netherlands. This dictionary ranks among the finest works ever written in relation to Malaysian phytophraphy. Its articles often twinkle with wit; its data are thoroughly reliable. Its only shortcoming is in that it is written in the Dutch language which is understood by many fewer than might avail themselves of this handbook.

Of BACKER's *Beknopte Flora van Java* (Concise Flora of Java), a mimeographed emergency edition, or *Nooduitgave*, began to appear in a very limited issue in November 1940. Till August 1949, eleven fascicles had appeared; it is expected to be completed in few years. BACKER received assistance in this final work from A. G. L. ADELBERT, G. J. M. AMSHOFF, R. C. BAKHUIZEN VAN DEN BRINK JR, H. J. LAM, A. D. J. MEEUSE, and S. J. VAN OOSTSTROOM, but wrote the major part himself.

Some of these authors participated in his *Notes on the flora of Java* (12).

BACKER's phytophraphy is composed with painstaking accuracy though he never loses himself in too much detail. Some of his manuscripts he kept unpublished for years, always reconsidering, improving, adding new facts. *Flora Malesiana* is proud to have persuaded him to participate in its composition. His unsurpassed, partly undistributed, Java collections rest in the Buitenzorg Herbarium.

His devotion to his science tolerates no casual

approach, no slipshod research. He criticized bitterly when he believed authors to be hasty and careless, an attitude which has been judged by some as too severe (13). Let us be thankful for unselfish fighters in a good cause.

BACKER spent nearly twenty years employed in the Buitenzorg Gardens, seven in the Herbarium at Pasuruan. The members of the staff of the Experiment Station of the Java Sugar Industry have furthered Javan phytophraphy considerably. A survey was written by VAN SLOOTEN (14).

In addition to the authors already mentioned (cf. also sub DOCTERS VAN LEEUWEN), I have referred to I. BOLDINGH's *Zakflora voor de landbouwstroken van Java* (1916, cf. § 95). J. G. B. BEUMÉE in 1913 employed in the Forest Research Service of Java, some time Head of the Buitenzorg Herbarium (1924-'31) and since 1948 Lecturer in the Agricultural College at Wageningen, specialized in the flora of the teak forests (15). He wrote several papers on the Javan vegetation (16).

A. H. BLAAUW published *De Tropische Natuur in Kleuren en Schetsen* (1913). De 'Natuurhistorische Vereniging' published some attractive popular books which contained some good phytophraphy: I select *Uit de Tropische Natuur* (1925, H. G. DELSMAN), *Vacantie in de bergen* (1927, S. J. GEERTS-RONNER), and *In tuinen en langs wegen in de Indische laagvlakte* (1932, M. C. ENGLÉS-JULIUS).

*References:* (1) BACKER, The problem of Krakatoa as seen by a botanist (1929); also Vakbl. voor Biol. 12 (1931) 157-162. (2) Ann. Jard. Bot. Btzg, Suppl. III (1909) 393-420. (3) Trop. Nat. 1-3 (1912-1914) *passim*. (4) Teysmannia 22, 24-28 (1912-1917) *passim*; also in Veeartsenijk. Bladen 25-29 (1913-1917) *passim*. (5) Bull. Jard. Bot. Btzg II, 12 (1913) 1-40. (6) Trop. Natuur 5 (1916) 87-94. (7) *ibid.* 5 (1916) 113-121, 136-137. (8) *ibid.* 6-11 (1917-1922) *passim*. (9) *ibid.* 7-8 (1918-1919) *passim*. (10) *ibid.* 2 (1913) 165-168, 177-179; *ibid.* 3 (1914) 11-16; *ibid.* 9 (1920) 1-4, 19-32. (11) Brittonia 3 (1938) 75-90. (12) Bull. Jard. Bot. Btzg III, 16 (1939) 107-212; Blumea 5 (1945) 490-524; *ibid.* 6 (1947) 302-309; *ibid.* 6 (1948) 310-336. (13) BACKER, Kritiek op de Exkursionsflora von Java (1913); cf. also KOORDERS, Opmerkingen over eene Buitenzorgsche kritiek (1914). (14) Soerabaiasch Handelsbl., 9 Juli, 1937. (15) BEUMÉE, Floristisch-anal. onderzoek in . . . djatiplantsoenen (1922). (16) Trop. Natuur 6-20 (1917-1931) *passim*.

#### 101. Recent phytophraphy of Sumatra

At the beginning of the 20th century, the largest work on the Sumatran flora was that of MIQUEL (1860-1861, cf. § 48) but his attempt towards a comprehensive Flora of Sumatra fell short of its mark. No further effort was made to compose a general Sumatran Flora and till now Sumatra's phytophraphy was added to incidentally. In this present account only the most important work is briefly touched on.

The Sumatran flora was chiefly investigated by Dutch, American, and English phytophraphers.





VALETON



DE VRIESE



WALLICH



WARBURG

The Botanical Garden at Sibolangit (1), its bright possibilities and its regrettable failure, has been alluded to in § 95. Collectors in the Dutch service were e.g. BÜNNEMEYER (§ 97), C. W. F. GRASHOFF (1914–1916); on behalf of the Forestry Service, A. THORENAAR and F. H. ENDERT (§ 109) practised 'intensive collecting' in the forested areas of the Palembang region (c. 1924).

KOORDERS's *Systematisches Verzeichnis* (1914–1916, § 73) contains a list of Sumatran records. J. J. SMITH enumerated all known Orchids of Sumatra (§ 96). C. G. G. J. VAN STEENIS (cf. § 99) explored the Ranau region in S. Sumatra (2) and added also to the knowledge of the Sumatran flora in the *Pteridophyten und Phanerogamen der Deutschen Limnologischen Sunda Expedition* (§ 99). He made an expedition into the Alas and Gajolands (N. Sumatra) which led to the discovery of several SE. Asiatic continental species in the mountains and furnished many valuable data both to phytography and plant geography (§ 99).

Numerous popular papers, certainly not without phytophographical interest, are found in 'De Tropische Natuur' (e.g. by S. C. J. JOCHEMS, J. C. VAN DER MEER-MOHR, A. FREY-WYSSLING, C. N. A. DE VOOGE, and M. VAN DER VOORT).

B. POLAK wrote on Sumatran bogs and peat (3). O. POSTHUMUS, pteridologist (§ 108) and palaeobotanist (§ 110), travelled in 1925 in Djambi where he collected both living and fossil plants on which he wrote some studies (4).

American interest in the Sumatran flora (since HORSFIELD (§ 40)) was revived by resident employees of the East Coast plantations. Large amounts of materials were gathered by H. H. BARTLETT and C. D. LARUE (1918–1927), H. S. YATES (1923–1928), RAHMAT SI BOEEA (1927), B. KRUKOFF (1931–1932), the BANGHAMS (1932–1932), and the VANDERBILT expedition (1939). BARTLETT wrote a survey of the work done in particular by Americans in the Battak Lands (5). MERRILL is obviously the foremost contributor to Sumatran phytophraphy based on these collections. He published *Notes on the Flora of Sumatra* (6), on the BANGHAMS's collection (7), four instalments of *New Sumatran Plants* (8), and on the specimens of the VANDERBILT expedition (9).

English participation consisted first of all of

RIDLEY's publications (§ 88). The plants collected by H. O. FORBES in Sumatra (c. 1880) were treated only forty years later, in 1924–1926 (10).

This brief outline sufficiently demonstrates why I am not prepared to agree with BURKILL's judgment (1939): 'such attention as its Flora received was the overflow of energy bestowed on Java'. Expeditions, local collectors, the Forest Service, residents of various nationalities did good work, either independently from that done in Java or in conjunction with the natural centre of phytophraphy in the Netherlands East Indies at Buitenzorg. It is true, however, that Sumatran phytophraphy is far less advanced than that of Java and that its Flora has too little been studied with the aim of treating the whole of the island. PENNANT's dictum of 150 years ago still stands: 'Sumatra still wants its florist.'

*References:* (1) Tectona 14 (1921) 693–711. (2) Bull. Jard. Bot. Btzig III, 13 (1933) 1–56. (3) Trop. Natuur 22 (1933) 117–224; Verh. Kon. Akad. Wet. Amsterdam, sect. 2, 30 (1933) 1–85; Landbouw 17 (1941) 1033–1062. (4) Versl. Kon. Akad. Wet. Amsterdam, sect. 2, 36 (1927) 428–434; Leidsche Geol. Meded. 5 (1931) 485–508. (5) Univ. Philip. Nat. Appl. Sci. Bull. 4 (1935) 211–323. (6) Philip. J. Sci. 14 (1919) 239–250. (7) Contrib. Arn. Arb. 8 (1934) 1–178. (8) Pap. Mich. Ac. Sci. 19 (1934) 149–203, 20 (1935) 95–112, 23 (1938) 177–202, 24 (1939) 63–92. (9) Not. Nat. Ac. Sci. Philadelphia 47 (1940) 1–9. (10) Journ. Bot. 62–64, Suppl. (1924–26) 1–149.

#### 102. Recent phytophraphy of Borneo

A survey of the phytophraphy of Borneo, made at the start of the 20th century would suggest that Borneo's great forests and its mountain giant Kinabalu had been explored by plant collectors at least as often as the wilds of Sumatra. KORTHALS (§ 51), TEYSMANN and DE VRIESE (§§ 48, 53) were among the main travellers, as was H. LOW (§ 89) who had climbed Kinabalu for the first time (1851, 1858). J. MOTLEY had worked in Labuan (1852–1854) and at Banjarmasin where he was murdered in 1859 (1). A. W. NIEUWENHUIS had crossed from Pontianak to the East Coast (1896–1897, and 1898–1900). Mantri JAHERI had made fine collec-

tions on that occasion and so did HALLIER (cf. § 70) who had climbed Mt Klamm. The main sources of Bornean phytography, however, were found in BECCARI's collections, his *Malesia*, and in his *Nelle foreste di Borneo* (§ 78), and also in O. STAPP's description of Kinabalu plants (2).

The first half of the 20th century shows a rapid increase of the descriptive studies on the flora but still the same incidental progress of Bornean phytography; no general Flora of the island has been written. (cf. § 70). The English, Americans, Dutch, and Germans have the majority of phytographical publications to their name.

Roughly summarizing, it may be said that RIDLEY (§ 88) contributed very substantially in a series of papers extending over many years, *Additions to the Flora of Borneo and other Malay Islands* (3); he visited Sarawak and B. N. Borneo in 1905. RIDLEY enumerated the Orchids recorded from Borneo (4) and elaborated the Monocotyledonous families in HANS WINKLER's *Beiträge* (see below).

At Kew, H. K. AIRY SHAW repeatedly added to Bornean phytography. In particular he described several of the families contained in the herbarium assembled by the Oxford University Expedition to Sarawak in 1932; these studies formed part of the *Additions to the Flora of Borneo etc.* P. W. RICHARDS, who is responsible for the collections of the Sarawak Expedition, published on the ecology of the rain forest of Mt Dulit (6).

The main scene of field research in Br. N. Borneo remained Mt Kinabalu. Miss L. S. GIBBS wrote a particularly good book (7) on the Kinabalu flora in 1914. C. E. CARR, the Malayan orchidologist (§ 94), made large collections on the mountain (c. 1934), now preserved at Singapore (8). C. CHRISTENSEN and R. E. HOLTUM (§ 93) wrote on the Pteridophytes of Mt Kinabalu (9). At Sandakan, the Herbarium of the Forest Department Br. N. Borneo is now, after its destruction in the Pacific War, re-assembled by H. G. KEITH.

The centre of descriptive work in Sarawak is the Sarawak Museum where the 'Sarawak Museum Journal' is edited since 1911 (10). Curators of the Museum, and important collectors, were G. D. HAVILAND (1891-1895), J. HEWITT (1905-1909), and J. C. MOULTON (1909-1915); HAVILAND revised the *Naucleae* (11).

The Americans concentrated on the British section of Borneo, with the exception of E. D. MERRILL who compiled in 1921 a *Bibliographic enumeration of Bornean plants*, listing 4924 species of Phanerogams for the whole of Borneo. It is the most valuable key to Bornean phytography (12). In this connexion it is necessary to refer to G. MASUMUNE's Japanese *Enumeratio Phanerogamarum Bornearum* (1942) in which it was intended, on the base of MERRILL's work, to bring the census up to date. He refers to 7201 species of Phanerogams but this compilation was executed with a view to speed rather than accuracy and so the figure is certainly not reliable. In 1945 appeared an enumeration of Bornean pteridophytes by the same author.

MERRILL composed a survey of the botanical exploration of Borneo in 1930 (13). Another often

consulted work is *Plantae Elmerianae borneenses* (14), an annotated and descriptive list of the specimens gathered by A. D. E. ELMER, the collector and describer of Philippine plants (§ 82), who made also large collections in Br. N. Borneo.

Together with Miss M. L. PERRY, MERRILL wrote a local revision of Bornean *Syzygium* (15). There are also his *Additions to our knowledge of the Bornean flora* (16), *Plants from Banguey Island* (17), and three instalments of *New or noteworthy Bornean plants* (18).

Other American collections were those of F. W. FOXWORTHY (§ 83) and, the largest of all, of Chaplain J. CLEMENS and his intrepid wife Mrs M. STRONG CLEMENS (1915-1916, 1931-1933). Their specimens have been comparatively frequently referred to in literature (MERRILL, VAN STEENIS, HOLTUM, AMES, DANSER, etc.) but their herbaria still contain many undescribed discoveries.

The finest 20th century collection made by the Dutch in Borneo is probably that of F. H. ENDERT (1925) who went with the 'Midden Oost Borneo Expeditie' (Central East Borneo Exp.). Some preliminary report has been embodied in the 'Verslag' (19) but the collection as a whole was not studied though occasionally references may be met with in literature. Few publications written by Dutch authors treat Bornean plants only (20); these are usually considered as part of larger studies. There are, however, the studies on Bornean Orchids by J. J. SMITH (§ 96) and HALLIER's articles (§ 70).

Some popular publications were written by L. COOMANS DE RUITER (21).

HUBERT WINKLER, a German botanist, made an expedition into Borneo (1908) and published three, sufficiently detailed, papers on the vegetation of the SE. regions (23). L. DIELS and C. HACKENBERG also described the region (22).

HANS WINKLER brought home rich spoils from his Bornean trip of 1924-1925, with DAKKUS (§ 97) and RACHMAT of the Buitenzorg Gardens. His plants supplied the materials for a sequence of *Beiträge zur Kenntniss der Flora von Borneo* (24). E. IRMSCHER acted as general editor; the whole was planned in conformity of LAUTERBACH's *Beiträge* (§ 106). Collaborating photographers were MERRILL (§ 81), O. SCHWARTZ (many families), ALSTON (§§ 20, 64), E. IRMSCHER, L. DIELS (§ 106), R. PILGER, etc.

*References:* (1) Hook. J. Bot. & Kew Gard. Misc. 9 (1857) 148-153. (2) Trans. Linn. Soc. Bot. 4 (1894) 69-263. (3) Kew Bull. (1930-1946) *passim*. (4) J. Linn. Soc. Bot. 31 (1896) 261-306. (5) Kew Bull. (1935-1939) *passim*; Hook. Ic. Pl. 35 (1947) t. 3474. (6) J. Ecol. 24 (1936) 1-37; *ibid.* 340-360. (7) J. Linn. Soc. Bot. 42 (1914) 1-240. (8) Gard. Bull. 8 (1935) 165-240. (9) *ibid.* 7 (1934) 191-324. (10) Fl. Mal. Bull. no 5 (1949) 130. (11) J. Linn. Soc. Bot. 33 (1897) 1-94. (12) J. Roy. As. Soc. Str. Br. Spec. Numb. (1921) 1-637. (13) J. N.Y. Bot. Gard. 31 (1930) 185-191. (14) Univ. Calif. Publ. Bot. 15 (1929) 1-316. (15) Mem. Amer. Acad. Arts and Sci. 18 (1939) 135-202, repr. Mem. Gray Herb. Harv. Univ. 4 (1939) 135-202. (16) Philipp.

J. Sci. 21 (1922) 514-534; *ibid.* 30 (1926) 79-87. (17) *ibid.* 24 (1924) 113-116. (18) J. Roy. As. Soc. Str. Br. 85 (1922) 151-201; *ibid.* 86 (1922) 312-342; *ibid.* Mal. Br. 1 (1923) 22-45. (19) Aneta Comm. M.O. Borneo Exp. 1-3 (1925); Verslag v. d. M.O. Borneo Exp. (1925) 117-312. (20) *e.g.* J. Bot. 72 (1934) 1-12. (21) Trop. Natuur (1932-1936). (22) Bot. Jahrb. 60 (1926) 293-316. (23) Bot. Jahrb. (1909-14). (24) Mitt. Inst. Allg. Bot. Hamburg (1927-1937).

### 103. Recent phytophraphy of Celebes

From the preceding paragraph it will have been realized that Bornean phytophraphy on the whole has developed scarcely beyond its first stage, that of collecting, though some notable contributions towards a description of its flora are present. This state of affairs is even more evident as regards Celebes, the Moluccas, and the Lesser Sunda Islands. With the exception of Timor, no recent attempts towards a phytophraphy of one of these many islands has come to my knowledge.

After TEYSMANN (§ 53), FORSTEN (§ 52), BECCARI (§ 78), and WARBURG (§§ 78, 106) had explored in Celebes, KOORDERS spent 6 months in the extreme NE of the island (1894-1895). In 1898 he published a *Verslag* (Report) on these Minahassa observations and collections (1) which represented, after D. OLIVER's *Note* on J. G. F. RIEDEL's Gorontalo plants (2), another initial step towards a Flora of N. Celebes. P. & F. SARASIN, Swiss naturalists who travelled in many parts of the world, explored Celebes (chiefly from a geological and zoological point of view) between 1893 and 1896, and 1902-1903. The Peak of Maros was climbed. They wrote a *Reisen in Celebes* (1905). H. CHRIST gave an account of their Fern specimens (3).

R. SCHLECHTER (§ 106), who travelled twice in Malaysia (1901-1902, 1907-1910), described *Orchids* and *Asclepidaceae* from Celebes; (4). A. H. EVERETT, an English collector of objects of natural history explored in S. Celebes; his plants were described by W. B. HEMSLEY *c.s.* (5). W. KAUDERN, a Swedish ethnographer and zoologist, brought together on his journeys in the island a collection of Celebes plants (1917-1920) of which the *Orchidaceae* and *Ericaceae* were elaborated by J. J. SMITH (§ 96). L. VAN VUUREN, accompanied by RACHMAT and NOERKAS of the Buitenzorg Gardens, penetrated into S. Celebes (1912-1914); plants of this collection have incidentally been described. H. A. B. BÜNNEMEIJER, Buitenzorg's professional collector (§ 97) made a big collection on Mt Bonthain. G. KJELLBERG, a Swedish botanist also assembled a large herbarium in southern Celebes (1929) while S. BLOEMBERGEN, of the Forestry Service, made in 1939 a trip to W. Central Celebes. P. J. EYMA secured possibly the most important collection of S. and Central Celebes plants during his expeditions far into the interior in 1937-38. The Ferns collected by KJELLBERG were elaborated by himself and CHRISTENSEN (6). BLOEMBERGEN wrote a general account of his trip (7) and an unpublished mimeographed report kept by the

Forestry Service; EYMA's collection was wilfully destroyed (8).

To be noted here is also a collection made by C. MONOD DE FROIDÉVILLE, described by H. J. LAM *c.s.* (9).

VAN STEENIS, in his analysis of the mountain flora of Malaysia referred repeatedly to Celebean species (10).

F. K. M. STEUP, a Forestry Officer, worked several years in Celebes and wrote a number of papers on the forests of N. and Central Celebes, besides he composed some essays on the plant physiognomy of the island (11). These appeared in 'Tectona', the periodical edited at the Forestry Research Station at Buitenzorg since 1908; at the Station many valuable unpublished reports made by Forestry Officers in various parts of the Archipelago are preserved.

H. J. LAM is the author of a historical phytophraphy of Celebes (12); in 1931 he gave an outline of the vegetation of the Minahassa (13).

*References:* (1) Meded. 's Lands Plantent. 19 (1898); Nat. Tijd. Ned. Ind. 61 (1901) 250-261; *ibid.* 63 (1903) 76-89, 90-99; Bull. Jard. Bot. Btzg III, 1 (1918) 1-30. (2) J. Linn. Soc. Bot. 15 (1877) 97-100. (3) Ann. Jard. Bot. Btzg 15 (1898) 73-186; also Basler Naturf. Ges. 11 (1895-1897). (4) *e.g.* Tropenpfl. 5-7 (1901-1903) and Bot. Jahrb. 40 (1908) Beibl. 92, p. 1-19. (5) Kew Bull. (1896) 36-42. (6) Bot. Jahrb. 66 (1933) 39-70. (7) Tectona 33 (1940) 377-418. (8) Fl. Mal. Bull. no 4 (1948) 92. (9) Blumea 5 (1945) 554-599. (10) Bull. Jard. Bot. Btzg 14 (1936) 56-72. (11) Tectona 23-28 (1930-1935) *passim*, also Trop. Natuur 22-25 (1933-1936) *passim*. (12) Blumea 5 (1945) 600-640. (13) Trop. Natuur 20 (1931) 209-219.

### 104. Recent phytophraphy of the Moluccas

Moluccan research was still stimulated by RUMPHIUS's research (§ 21) centuries later. The wish to establish the identity of the plants he had described, induced later scientists to investigate the flora of Amboina and neighbouring islands.

REINWARDT (§ 46), among his many commissions, was charged in particular to search for Rumphian plants. TEYSMANN and DE VRIESE, on their Moluccan trip (§§ 48, 53), assembled a large and important collection, to some extent again with a view to establish the identity of RUMPHIUS's species.

Among general collections is to be noted that of H. N. MOSELEY, on occasion of the 'Challenger' Expedition (1872-1876), who secured valuable specimens; these and some materials collected by J. G. F. RIEDEL and H. O. FORBES were examined or described by W. B. HEMSLEY (§ 49). Mantri JAHERI, of the Buitenzorg Gardens, who accompanied TREUB in 1888 to the Moluccas and in 1893 to the Aroe and Kei Islands, has to be remembered among the hardest explorers. BECCARI's collections (1874-1876) were partly described in *Malesia* (§ 78).

An outline of the search in the Moluccan fields during the 19th century was given by O. WARBURG

(1), who himself contributed both as a collector and as a photographer (§ 78).

At the beginning of the 20th century, the quest for RUMPHIUS's plants was revived by BOERLAGE and SMITH; their trip ended in disaster (cf. § 68). Some ten years later C. B. ROBINSON made a new effort; he also met with death. MERRILL wrote some most valuable publications based on ROBINSON's data (cf. § 81).

The Talaud Archipelago was practically unknown (CH. HOSE had been there in 1895) when LAM (§ 99) made an expedition to these and the Sangi Islands in 1926. Some plant geographically significant species were brought home. A preliminary paper appeared in the proceedings of the 4th Neth. Ind. Congr. for Natural Sciences (1927), and a second paper (2) in 1932. In 1937 DOCTERS VAN LEEUWEN reported on the botanical results of his voyage to the Saleyer Islands (3).

V. M. A. BEGUIN collected 1919–1923 in the Moluccas (especially Halmahera) on behalf of the Museum for Economic Botany at Buitenzorg. G. A. L. DE HAAN, of the Forestry Service, assisted by ANANG and NEDI of the Buitenzorg Gardens, made collections in Batjan, Obi, Talaud, Halmahera, and Morotai (1937–1938); their specimens wait, with so many others, to be considered in the future revisions of the *Flora Malesiana*.

A. RANT wrote an account of his trips to Ambon (4). L. J. TOXOPEUS, an entomologist, led an expedition into Boeroe (1921–1922). Now and then his specimens are referred to in literature; J. J. SMITH described his orchids (§ 96).

Mantri IBOET, of the Buitenzorg Gardens, went with the Danish Expedition of HJ. JENSEN to the Aroe and Kei Islands, and to Ambon in 1922. IBOET proved to be an outstanding collector.

P. BUWALDA, of the Forest Research Station, Buitenzorg, brought together a big and extremely valuable herbarium in the Moluccas (Ceram, Ambon), the Tanimbar and the Aroe Archipelago (1938). He was accompanied by AËT, of the Herbarium.

TEYSMANN made the first important Ceram collection in 1860. He published some account of the vegetation as apart of his narrative of his journey (cf § 53). The island was investigated anew by L. M. R. and Mrs RUTTEN (1918); a very good herbarium was assembled by this mainly geological expedition. RUTTEN went also to Ambon. Part of the herbarium was made by KORNASI.

E. STRESEMANN, a Dresden zoologist, participated in the second Freiburgian Moluccas Expedition (1910–1912), on which the Malay Peninsula, Bali, Ceram, and Boeroe were visited. STRESEMANN secured a good collection of plants which allowed some first glimpses of the high mountain flora in the interior of Ceram. All these collections, however, were far surpassed by P. J. EYMA's Ceram herbarium (1938–39). His untimely death and, later on, the destruction of a part of his specimens, deprived the phytography of Ceram from a most satisfactory basis. A preliminary examination of his mountain specimens, however, has furnished a new and adequate picture of the characteristics of the Ceram vegetation in the higher parts.

SMITH described the Orchids of Ambon in 1905 and 1917, of Ceram in 1928, of Boeroe in 1928; the *Ericaceae* of the 'eastern Archipelago' in 1932 (cf. also § 96).

*References:* (1) Rumphius Gedenkboek (1902) 63–78. (2) Inter-Ocean 4 (1928) 195–201; Ind. Com. Wet. Ond. 6 (1932). (3) Blumea 2 (1937) 239–277. (4) Nat. Tijds. Ned. Ind. 94 (1934) 100–133.

#### 105. Recent phytography of the Lesser Sunda Islands

Since the time when CLUSIUS described the first Bali specimen (§ 9), no essential change occurred in the progress of the phytography of the Lesser Sunda Islands. Till the present day, the knowledge of their flora increased according to the collections made at irregular intervals and when an opportunity of describing these specimens arose.

Timor has been privileged in that some authors attempted to deal with its flora as a whole; actually, however, these phytographers had only some fragmentary collections at their disposal. They were J. DECAISNE and J. B. SPANOGHE, the former by his *Herbarii Timorensis descriptio* (1), the latter by a *Prodromus florum timorensis* (2). SPANOGHE also made a list of all known species from Timor (3) and paid much attention to the work of ZIPELIUS (§ 50). The work of both authors is now entirely outdated.

The Koepang district of Timor was, in the course of time, comparatively closely investigated. Koepang was the regular port-of-call on the way from Java to New Guinea. TEYSMANN visited Timor in 1854 (§ 53). He made a large collection and wrote an account of his observations (4). H. O. FORBES, heading for New Guinea, stayed 5 months (1882–1883). In his *Wanderings* (5) only a list of his Timor plants is given; a more critical and descriptive study was published by the botanists A. B. RENDLE, E. G. BAKER, and SP. MOORE in the 'Journal of Botany', Suppl. (1924–1926).

Mrs M. E. WALSH-HELD collected in the whole of Timor (1929); her large collection contains many valuable specimens.

Portuguese Timor has received less attention. A. O. DE CASTRO, a friend of TREUB's, wrote a book on his travels in the island and collected (c. 1909). J. G. ALFARO CARDOSO studied the forestry in recent years. Main collectors were CH. GAUDICHAUD (1818), FORBES (1883), F. NEWTON (1897), Mrs WALSH-HELD (1929), G. STEIN (1931–1932), E. MEIJER DREES (± 1946), and R. CINATTI (± 1946).

One or more of the other Lesser Sunda Islands were occasionally visited by plant collectors. In the 19th century, the most important was probably H. ZOLLINGER. He explored repeatedly Bali (1845, 1846, 1857), once Lombok (1846), and made in 1847 a 4-month trip into Soembawa (§ 54).

In the first half of the 20th century are to be noted the 'Sunda Expedition' of the 'Frankfurter Verein für Geographie und Statistik' (1910–1911) under J. ELBERT, who visited Lombok, Soembawa, Flores, and Wetar. H. HALLIER described part of the collections (§ 70).

R. E. P. MAIER, with SARIP of the Buitenzorg Herbarium, made a collection of plants in the west and central part of the island (1918). IBOET, another collector of the Herbarium, went with K. W. DAMMERMAN to Sumba (1925); the trip was chiefly for zoological purposes but a valuable set of plant specimens was secured (6).

In 1927, B. RENSCH and Mrs I. RENSCH travelled in Bali, Lombok, Soembawa, and Flores (7). This German zoological expedition, through the care of Mrs RENSCH, added to the phytophraphy of the Lesser Sunda Islands by a fine herbarium. Mrs RENSCH examined and described the Ferns herself (8); the Phanerogams were partly elaborated by J. VON MALM (9).

C. N. A. DE VOOGD, in charge of the forests of the Lesser Sunda Islands (1933-1937) utilized the chance for making collections and observing the vegetation very well. His *Botanische Aanteekeningen* deal with all the major islands (10).

VAN STEENIS worked also in Bali (1936). He published his notes in two papers (11). He wrote on fossilized woods of Sumba and Sumbawa (12) in connexion with his plant geographical theories (§99).

O. JAAG, a Swiss lichenologist, collected in Bali, Flores, and Alor (1938), mainly Cryptogams but also a large amount of Phanerogams. Miss C. DU BOIS's collection was worked on by VAN STEENIS (13). She was an American ethnographer who made studies in Alor in 1938-1939.

S. BLOEMBERGEN, a Dutch systematist then in the employ of the Forestry Service, travelled in 1939 in the Lesser Sunda Islands. He explored especially the forests of Wetar (14).

A survey of the Ferns of the Lesser Sunda Islands was written by O. POSTHUMUS (§§ 100, 108) and published in 1943 (15); this was accompanied by an account of the botanical explorations of the islands more detailed than could be given here and from the pteridologist's point of view. The present survey only conveys some idea of the amount of material still waiting to be revised in the future instalments of *Flora Malesiana*.

*References:* (1) Ann. Mus. Hist. Nat. Paris 3 (1834) 345-501 (1835). (2) Linnaea 15 (1841) 161-208, 314-350, 476-480. (3) Hook. Comp. Bot. Mag. 1 (1836) 344-351. (4) Nat. Tijd. Ned. Ind. 14 (1856) 111-206. (5) FORBES, A Naturalist's Wanderings (1885) 415-488. (6) Trop. Natuur 15 (1926) 75-82; Nat. Tijd. Ned. Ind. 87 (1926) 27-122; Verh. Kon. Akad. Wet. Amsterdam, 2e sect., 33 (1930) 871-875. (7) RENSCH, Eine biologische Reise nach den Kleinen Sunda Inseln (1930). (8) Hedwigia 74 (1934) 224-256. (9) FEDDE, Rep. 34 (1934) 255-307. (10) Trop. Natuur 25-30 (1936-1941) *passim*. (11) *ibid.* 25 (1936) 158-159; *ibid.* 26 (1937) 69-78. (12) Chron. Nat. 103 (1947) 237-239. (13) Blumea 6 (1948) 247-262. (14) Tectona 33 (1940) 110-196. (15) Ann. Jard. Bot. Buitenzorg, hors série (2603 = 1943) 35-113.

#### 106. Recent phytophraphy of New Guinea

Javan phytophraphy, chiefly by the efforts of a single phytophrapher of outstanding merit, and also

because of the easy accessibility of the wild flora from Buitenzorg, has shown most progress. Sumatra and certainly also Borneo being both decidedly less explored and the collections less studied, cannot dispose of a fund of literature comparable to that of Java. In the preceding paragraphs, it was demonstrated that, though the size and number of collections of the 'eastern archipelago', *i.e.* Celebes, the Moluccas, and the Lesser Sunda Islands, are more conducive to an advanced phytophraphy than 'those of Borneo and Sumatra, the arrears in the elaboration of the materials are so large that their phytophraphy is probably even more backward even if the comparatively poorer flora is taken into account. In the 20th century, the botany of New Guinea has roused a vivid interest with the result that New Guinean phytophraphy is rapidly progressing.

The collections secured by expeditions or residents were eagerly expected and in the course of few years either consecutive series of articles or individual papers appeared; a splendidly executed periodical 'Nova Guinea' was entirely devoted to the natural history of this great island, a plant geographical outpost of the utmost significance, a vast area of land, harbouring many known, many unknown, autochthonous botanical marvels.

The phytophraphy of New Guinea may be separated into three groups of contributions, though some explorers or authors have extended their work beyond the limits adopted here. Starting in the West of the island, the phytophraphy of the Dutch territory is to be considered, secondly, that of the northeastern parts (largely from German sources) and finally that of the southeast, where chiefly British and Australian botanists worked. The political boundaries have caused that the three groups of phytophraphers paid often but little attention to what had been described over the border, but a few favourable exceptions exist. On the whole, however, the phytophraphy of New Guinea was developed by a peaceful collaboration of many nations.

Some efforts were made to bring method into the rapid progress of New Guinean phytophraphy ('Nova Guinea', LAUTERBACH's *Beiträge*) but the whole remained chaotic and there is no reason to expect much endeavour towards synthesis in a near future. Many thousands of specimens gathered on the frequent expeditions into various parts of the island wait study; here again, the *Flora Malesiana* may contribute decisively towards a co-ordinated knowledge of the New Guinean plant world.

(1) *Dutch West New Guinea*. C. L. BLUME (§ 47) chiefly in his *Rumphia* and F. A. W. MIQUEL (§ 48) in his *Annales* referred, in the 19th century, to West New Guinean plants (ZIPELIUS, § 50). TEYSMANN (§ 53) made a collection in 1871 and SCHEFFER (§ 55) wrote in the first volume of the Buitenzorg *Annales* an account of what had been achieved till that date (1876) including several new plant descriptions (1). BECCARI visited the island three times (1871, 1875, 1876) and explored in particular the Arfak Mountains and 'Vogelkop'; the majority of his finds were described in *Malesia* (§ 78).



WHITE



WILLDENOW



HUB. WINKLER



ZOLLINGER

O. WARBURG (§ 78) added to the phytography of western New Guinea and adjacent regions (2). VALETTEON gave, after TREUB and JAHERI's trips (1893, 1901, § 65) another enumeration (3).

With the aid of the 'Maatschappij ter bevordering van het Natuurkundig Onderzoek der Nederlandsche Koloniën' (Society for the Advancement of the Natural Sciences in the Netherlands Colonies) and the 'Indisch Comité voor Wetenschappelijke Onderzoekingen' (Neth. Ind. Committee for Scientific Research)—both organizations had repeatedly supported botanical exploration in the Archipelago (Borneo)—a periodical began to appear in 1903, entitled 'Nova Guinea'. This was issued at irregular intervals and as separate reprints were distributed in advance of the official date of publication, many new names contained in it cause difficulties in matters of priority. On the other hand, 'Nova Guinea', sponsored by the Netherlands Government, is the most sumptuously edited periodical devoted to New Guinea in existence.

'Nova Guinea' was intended to receive work on the ethnography, geography, zoology, and botany of the island, based in particular on the results of the 20th century Dutch expeditions. Volumes 8 (1909–1914), 12 (1913–1917), 14 (1924–1932), and 18 (1926 →) so far have been occupied by phytography; they were edited by Dr A. A. PULLE. C. E. A. WICHMANN composed a detailed survey of the exploration of New Guinea in the first volume. He was also the leader of the expedition in which H. A. LORENTZ participated (1903). G. M. VERSTEEG accompanied the 2nd LORENTZ Expedition of 1907, and also the 2nd of A. FRANSSEN-HERDERSCHEE (1912–1913), in which PULLE took part. VERSTEEG and PULLE (later a Professor of Botany at Utrecht who specialized in the botany of Surinam) are among the foremost Dutch collectors.

To be noted are also the collections of J. W. R. KOCH, a physician and ethnographer who penetrated into SW. New Guinea in 1904–1905 on an expedition sponsored by the 'Koninklijk Nederlandsch Aardrijkskundig Genootschap', the large one of L. S. A. M. VON RÖMER (1909–1910, to S. New Guinea), of M. MOSZKOWSKY (a German, who travelled in the Mamberamo region, 1910–1911), of R. F. JANOWSKY (an Austrian, who collected in the same region, 1912–1914), and of K.

GJELLERUP (a Dane, who was accompanied by AJOEB of the Buitenzorg Gardens when he explored in Dutch N. New Guinea with the Dutch-German boundary commission, 1910–1911). The latter two collectors belonged with some others, e.g. W. K. H. FEUILLETAU DE BRUYN and A. CH. T. THOMSON, to the so-called exploration detachments (13).

English contributions to the phytography of Dutch New Guinea consisted e.g. of Miss L. S. GIBBS's valuable work on the Arfak Mountains (4), and RIDLEY's description (§ 88) of A. F. R. WOLLASTON's plants (5) collected on an expedition to the Carstensz Mountains; partly together with C. BODEN KLOSS (§ 101), WOLLASTON assembled a large herbarium (1910–1913) in South New Guinea.

A new Dutch expedition (1920–1921) to the Mamberamo River and the Wilhelmina Mountains was made by H. J. LAM (§§ 99, 104) who wrote extensive travel accounts (6); besides he studied New Guinean plant geography and added to its phytography (7). W. M. DOCTERS VAN LEEUWEN (§ 97) joined the Dutch American STIRLING expedition of 1926 and added considerably to the large collections he had made in other parts of the Archipelago. E. MEIJER DREES accompanied L. J. BRASS on the 3rd ARCHBOLD Expedition of 1939 and again vast amounts of herbarium were preserved (8). E. MAYR, a German-American ornithologist collected in the Arfak Mountains and near Geelvink Bay (1928). P. J. EYMA (§§ 103, 111) extended his explorations to the Wissel Lakes (1939); the fate of his exemplary collections was mentioned before (§§ 103, 104). R. KANEHIRA and S. HATUSIMA made a fine collection on their trip into the interior (Geelvink Bay region) in 1940, which formed the material base of a series of articles (9). The Sorong area was explored by the Swedish S. BERGMAN expedition in 1948 (10). The Forestry Service had much exploratory work done on the forests e.g. in the region and islands of Geelvink Bay (L. J. VAN DIJK) and of McCluer Gulf (Z. SALVERDA); these two forest officers wrote each a report (11, 12). E. LUNDQUIST made collections in the swamp forests of the South (1941).

From these collections, and some not mentioned here, a variety of publications resulted appearing in more than a dozen periodicals. Among the



numerous phytophagists who wrote in 'Nova Guinea', I select, rather arbitrarily, BECCARI (1909), A. ENGLER and K. KRAUSE (1910, 1912, 1924, 1927), H. HALLIER (1913, 1914), C. LAUTERBACH (1910-1912), A. A. PULLE (1910, 1912), TH. VALETON (1911); the Orchid descriptions of J. J. SMITH occupy considerable space in these volumes. Much phytophagy pertaining to New Guinea is also found in 'Blumea' and in the 'Bulletin of the Botanic Gardens, Buitenzorg'.

(2) *Northeast New Guinea*. The phytophagy of the northeastern, formerly German, part of New Guinea is probably most advanced.

A first *Flora von Kaiser Wilhelmsland* by K. SCHUMANN and U. M. HOLLRUNG was published in 1889; the former composed with C. LAUTERBACH *Die Flora der Deutschen Schutzgebiete in der Südsee* (1901) which was supplemented by *Nachträge* in 1905; this latter was the largest volume. To O. WARBURG's work I have referred before (§§ 78, 104, and this paragraph).

The flora of the Kaiserin Augusta Fluss (or Sepik River) was explored repeatedly. The largest collections were assembled by the Swiss C. L. LEDERMANN (1912-1913) who was the botanist of the German expedition to that region. Important material were also the specimens of U. M. HOLLRUNG (1885-1888), F. C. HELLWIG (1888-1889; Finisterre and Sattelberg Mountains), C. LAUTERBACH (1896-1899), G. BAMLER (1898-1899), F. R. R. SCHLECHTER (1901-1903, 1906-1910), G. PEEKEL (14), and CHR. KEYSER (1909-1919).

It was felt, that the flora of Kaiser Wilhelmsland, searched so industriously by many collectors, deserved a special medium of publication and so, in 1912, *Beiträge zur Flora Papuasiens* began to appear under the editorship of C. LAUTERBACH (later continued by L. DIELS, who elaborated many families); in 1942 the 26th instalment appeared. LAM compiled a list of the families elaborated till 1934 (15).

A special fund, the 'H. und E. HECKMANN-WENTZEL Stiftung' financed the majority of the explorations. A. ENGLER, in his 'Botanische Jahrbücher' undertook to publish the *Beiträge*. The limits of 'Papuasiens' vary according to the author. Often (German) New Guinea is the centre, sometimes the adopted boundaries extend as far as Celebes to the West and the Solomons to the East.

The *Beiträge* contain more than a hundred of papers, several large, the majority brief. Quite a number are accompanied by geographical notes. Some of the phytophagists collaborating in the series are: O. BECCARI (1914-1923), L. DIELS (1912-1940), A. ENGLER and K. KRAUSE (1912-1932), H. HARMS (1917-1942), E. IRMSCHER (1913), G. KÜENTHAL (1924, 1940), C. LAUTERBACH (1912-1929), FR. MARKGRAF (1924-1936), R. PILGER (1914-1939), R. SCHLECHTER (1912-1928), H. SLEUMER (1939-1942), TH. VALETON (1914-1927), HUB. WINKLER (1922). A comprehensive paper on the Pteridophytes appeared in 1921 by G. BRAUSE.

This survey of German sponsored phytophagy may be concluded by a reference to M. BURRET's

outstanding work (16) on Palms *e.g.* *Neue Palmen aus Neu Guinea* (1933-1937). He wrote several papers on other groups *e.g.* on *Tiliaceae* and some contributions to the L. J. BRASS collections (17). R. SCHLECHTER titled his largest work *Die Orchidaceae von Deutsch Neu Guinea* (1912-1914); he is the describer of more than a thousand New Guinean Orchids, new to science. C. MEZ described New Guinean *Myrsinaceae* (18).

Contrary to the custom of the Manila Herbarium (§§ 85, 107) the German botanists have preferred to keep the whole of the collections from New Guinea under their care and distributed only rarely duplicates; frequently all materials have been kept at Berlin. The consequence is that with the destruction of the Berlin-Dahlem Herbarium in the latest European war (29) numerous typifying specimens are lost and that all available information for the present and for all time is their description. In deciding critical points, the type specimen may be, and often is, indispensable.

The annihilation of the Berlin collections means a blow to New Guinean phytophagy from which it will suffer a long time. It is fortunate that at Wrocław (Breslau) a certain amount of duplicates seems to have survived.

Finally, to be mentioned among recent collectors, is Mrs MARY STRONG CLEMENS who secured vast collections, chiefly of mountain plants 1935-1940 (*cf.* also § 102).

(3) *Southeast New Guinea*. British New Guinea, or the Territory of Papua, had been visited in the 19th century by H. O. FORBES whose plants were elaborated much later (*cf.* § 105). W. BOTTING HEMSLEY *c.s.* worked on the collections of A. GIULIANETTI (Mt Scratchley, *c.* 1896) and of A. L. ENGLISH, in the Kew Herbarium (19).

Sir W. MACGREGOR, Administrator of British New Guinea, searched the Owen Stanley Range in 1889. He stimulated collecting and furthered New Guinean phytophagy considerably by giving F. VON MUELLER all support he was able to (20). VON MUELLER's descriptions of Papuan plants are scattered in a host of small articles, often in rare periodicals (*e.g.* 'the Victorian Naturalist' (21), 'WING's Southern Science Record' (22), and 'Melbourne Chemist and Druggist'). His main work is, as regards Malaysian botany, *Descriptive Notes on Papuan Plants*, which was discussed previously (§ 64).

F. M. BAILEY continued VON MUELLER's work after the latter's death (1896) and described several collections from Papua in the 'Annual Reports of Papua and British New Guinea' and especially in the 'Queensland Agricultural Journal' (vols 7-26) as *Contributions to the New Guinea Flora*.

BAILEY, the author of important works (§ 64) died in 1915; the phytophagy of New Guinea was then continued by C. T. WHITE, Government Botanist of Queensland, in the Melbourne Herbarium, assisted by W. D. FRANCIS and of recent years by S. T. BLAKE.

WHITE wrote *A Contribution to our knowledge of the Flora of Papua* (23) and on the ligneous



plants collected (1925–1926) by L. J. BRASS (24). Together with FRANCIS he described C. E. LANE-POOLE's specimens (25). BLAKE showed a preference for *Cyperaceae* and *Gramineae* (26).

LANE-POOLE wrote an important report, *The Forest Resources of the Territories of Papua and New Guinea* (1925). G. BURNETT's *Timber Trees of the Territory of Papua* was one of the earliest publications in this field (1908).

American participation in New Guinean plant description centres round the RICHARD ARCHBOLD Expeditions (1933–1934, 1936–1937, and 1938–1939, the Dutch-American Expedition).

These penetrated mostly into the interior of Papua (Owen Stanley Range, Fly River region; the 1938–1939 expedition reached the 'Snow' or Wilhelm Mountains in Dutch New Guinea). Leader of the botanical explorations was L. J. BRASS, who assembled New Guinean collections of unequalled size and quality. Some papers contain his observations (27).

The largest American publication dealing with New Guinean phytophany is E. D. MERRILL and L. M. PERRY's *Plantae Papuanae Archboldianae*, based on BRASS's specimens (and also on the collections of some others, e.g. C. E. CARR, cf. §§ 94, 102).

This series began in 1939 in the 'Journal of the Arnold Arboretum' and, though the editors elaborated most families or groups personally, by the assistance of a number of American and other phytophographers, proceeded rapidly. In 1949, the 18th and final instalment was published which included an index to the series. Additional papers, supplementary to the series though not titled as such, (many are indicated as *Botanical Results of the Archbold Expeditions*), and also based on BRASS's specimens, are contained in the same 'Journal'. I mention C. T. WHITE (*Myrtaceae*, 1942, 1947, 1948), L. DIELS (*Annonaceae* and *Menispermaceae*, 1939), M. BURRET (*Palmae*, 1939), H. UITTEN (*Cyperaceae*, 1939), F. W. PENNELL (*Scrophulariaceae*, 1939–1943), V. S. SUMMERHAYES (*Ficus*, 1941) C. E. KOBUSKI (*Theaceae* and *Oleaceae*, 1940), and there are others.

A. C. SMITH wrote *Studies on Papuan plants* in 6 instalments in the 'Journal' (1941–1944). The

grasses were in particular studied by A. S. HITCHCOCK and A. CHASE (*Papuan Grasses*, 3 inst., 1936–1943) and by J. R. REEDER who made a thesis on the *Gramineae-Panicoideae of New Guinea* (1948). MERRILL and PERRY worked also on CLEMENS's plants (28).

*References:* (1) Ann. Jard. Bot. Btzg 1 (1876) 1–60, 178–187. (2) Bot. Jahrb. 13 (1891) 230–454; *ibid.* 16 (1892) 1–32; *ibid.* 18 (1894) 184–212. (3) Bull. Dép. Agric. Ind. néerl. 10 (1907); cf. also Fedde Rep. 5 (1908) 377–397. (4) GIBBS, Dutch N.W. New Guinea (1917). (5) Trans. Linn. Soc. London, Bot., ser. 2, 9 (1916) 1–269. (6) Nat. Tijd. Ned. Ind. 87 (1927) 110–180, 187–227, 252–324; *ibid.* 88 (1928) 67–140; *ibid.* 89 (1919) 193–288; Engl. transl. of series in Sargentia 5 (1945) 1–196. (7) Trop. Natuur 11 (1922) 38–45; *Teysmannia* 32 (1921) 289–326; *Blumea* 1 (1935) 115–159; KARSTEN & SCHENCK, Vegetationsbilder, Reihe 15, Heft 5–7, Taf. 25–42 (1924). (8) J. Arn. Arb. 22 (1941) 271–342. (9) Tokyo Bot. Mag. (1941–1943) *passim*; cf. Fl. Mal. Bull. no 2 (1947) 48–49. (10) *ibid.* no 5 (1949) 129. (11) L. J. VAN DIJK, Boschbedrijf en boschbeheer in de Residentie Molukken, in het bijzonder in Noord-Nieuw-Guinea. Mimeogr. Report. 1940. (12) SALVERDA, Rapport van een oriënterende exploratie in Z.W. Nieuw Guinea, Dienst v/h Boschw. Ned. Ind., ill. mimeogr. rep. 1938. (13) Verslag v. d. Militaire Exploratie van Nederlandsch-Nieuw Guinea 1907–1915 (1920) 440 pp. photos, maps. (14) Fl. Mal. Bull. no 2 (1947) 44; *ibid.* no 5 (1949) 124. (15) *Blumea* 1 (1935) 115–159. (16) Notizbl. Bot. Gart. Mus. Berlin-Dahlem (1933–1937); cf. also *ibid.* 10 (1927–1930) 198–201; Fedde Rep. 24 (1928) 253–296. (17) J. Arn. Arb. 12 (1931) 264–268; *ibid.* 20 (1939) 187–212. (18) Bot. Arch. 1–2 (1922–1923) *passim*. (19) Kew Bull. (1899) 95–126. (20) Nature 42 (1889) 382–383. (21) Vict. Nat. (1884–1896) *passim*. (22) Wing's South. Sci. Rec. (1882–1887) *passim*. (23) Proc. Roy. Soc. Queensl. 34 (1922) 5–65. (24) J. Arn. Arb. 10 (1929) 197–274. (25) Proc. Roy. Soc. Queensl. 38 (1927) 225–261; *ibid.* 39 (1928) 61–70. (26) *Blumea*, Suppl. 3 (1946) 56–62; J. Arn. Arb. 28 (1947) 109–116, 207–229; *ibid.* 29 (1948) 90–102. (27) *ibid.* 22 (1941) 271–342. (28) *ibid.* 29 (1948) 152–168. (29) Kew Bull. (1949) 172–175.

## MALAYSIAN PHYTOGRAPHY AT PRESENT

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### 107. *The present state of Malaysian phytophany*

From the preceding paragraphs a general picture may be formed of the present state of Malaysian phytophany. Therefore, some brief, as it were supplementary, notes will suffice here.

In the United States of America, the attention is mainly directed to New Guinea (§ 106) and the Philippines (§§ 80–85); some time is also devoted

to the study of the Sumatran flora (§ 101), and to that of Borneo (§ 102). The largest collections present in North America are of New Guinea and of the Philippines; after the destruction of the Manila Herbarium, the systematical research of the Philippine vegetation will have to rest very largely, for many years to come, on the materials preserved in the Herbaria of the United States. The foremost Herbaria in this respect are those of the Harvard

University (Arnold Herbarium, Gray Herbarium), the U.S. National Herbarium (Smithsonian Institution), and the Herbarium of the New York Botanical Garden. In the paragraphs cited above, several of the American phytophagists now contributing to Malaysian phytophagy are referred to. In addition I wish to add the name of L. O. WILLIAMS (1) who described recently *Orchids* and *Corsiciaceae* collected on the 3rd ARCHBOLD Expedition.

In Great Britain, the largest collections of Malaysian plants are kept at Kew and in the British Museum Department of Botany. The majority of the publications on the subject are contained in the 'Kew Bulletin', the 'Journal of Botany', and the 'Journal of the Linnean Society of London (Botany)'. The interest paid to Malaysian botany is, of course, focused on the Malay Peninsula (§§ 86-94) and Borneo (§ 102); incidentally contributions to the phytophagy of other parts of Malaysia appear (§§ 101, 104).

In the paragraphs just mentioned I have not yet made reference to E. NELMES, author of a key to Malaysian *Carex* (2).

In the Netherlands, the largest Malaysian collections rest in the Rijksherbarium at Leyden (MIQUEL's Herbarium (§ 48) mainly at Utrecht). At Leyden, Malaysian phytophagy is a prominent subject of study (cf. §§ 99-106). S. J. VAN OOSTSTROOM (§ 10) prepared there his monograph of *Convolvulaceae* (3), Miss J. KOSTER her revision of part of the *Compositae* (4) and her Dutch edition of MERRILL's *Plant life of the Pacific World* (1949). In the Utrecht Herbarium were prepared a number of Doctor's theses. Recent ones are e.g. the monograph of the *Burmamiaceae* by F. P. JONKER (1938) and the revision of the *Melastomataceae* of the Malay Archipelago (5) by R. C. BAKHUIZEN VAN DEN BRINK Jr (§ 100). At Groningen P. BUWALDA, a pupil of DANSER's, wrote a revision of *Umbelliferae* (12), S. BLOEMBERGEN (§ 105) published on *Alangiaceae* (6), and J. WASSCHER on *Podocarpus* (13).

The periodicals 'Nova Guinea', 'Blumea', and the 'Receuil des travaux botaniques néerlandais' contain the major part of Malaysian phytophagy.

In Germany, Malaysian plants were mainly described in the Herbarium at Berlin-Dahlem, and at the Hamburg Botanical Institute. Though New Guinea was preferably studied (§ 106), there was also a definite interest in the Bornean flora (§ 102), and in that of the 'eastern archipelago' (§§ 103-105). The periodicals to be remembered first are 'Botanische Jahrbücher', the Hamburger 'Mitteilungen', the 'Notizblatt' (Berlin-Dahlem), FEDDE's 'Repertorium', and the serial 'Das Pflanzenreich'. Not mentioned so far was W. DOMKE's work on *Thymeleaceae* (14).

Although it is to be feared that the loss of the Berlin Herbarium (§ 106) will reduce German contributions for some time to come, G. KÜENTHAL's recent studies in *Rhynchosporoideae* ought not to pass unmentioned (7) nor H. SLEUMER's studies in *Ericaceae* (15) of New Guinea, in *Rhododendron* (16), and in *Vaccinioideae* (17).

In France the 'Muséum National d'Histoire Naturelle de Paris' keeps the largest Malaysian collections. Occasionally some addition to Malaysian phytophagy comes from French sources apart from the valuable work done in respect to the phytophagy of Indo-China. LECOMTE's 'Notulæ Systematicæ', and the 'Bulletin du Muséum' are to be noted. It is to be regretted that the French phytophagists in recent years have had no facilities to participate to such an extent in the development of Malaysian plant description as French plant exploration would have justified. A number of articles on *Apocynaceae* (partly Malaysian) was published in rapid succession by M. PICHON (8).

Switzerland, in possession on the treasures of the DELESSERT Herbarium and the inheritance of the DECANDOLLE's, will remain a main source of materials and data. The collections are at Geneva in the 'Conservatoire et Jardin botaniques'. Incidental contributions appear, as a rule, in 'Candollea'.

In Italy, BECCARI's collections are preserved at Florence. Malaysian phytophagy is rarely the subject of descriptive articles but, if so, usually in the 'Nuovo Giornale' and, possibly, in 'Webbia' (resumed in 1949).

In India, the Calcutta Herbarium, issuing the particularly beautiful 'Annals of the Calcutta Botanic Garden', produces the largest amount of work of interest to Malaysia. A second periodical of importance is the 'Journal of the Asiatic Society of Bengal'.

In Ceylon, Peradeniya has not been able to maintain its former glory. The main periodical in our field is the 'Ceylon Journal of Science, Section A. Botany'.

In Australia the Herbaria at Brisbane, Sydney, and Melbourne contribute to Malaysian phytophagy, chiefly to that of Papua. The position was generally outlined in § 106.

In China, contributions to Malaysian phytophagy are found in 'Sunyatsenia', 'Sinensia', &c.; in Japan, in various botanical journals. Publishing authors are T. NAKAI (§§ 12, 111; (9)) S. HATUSIMA (§ 106; (10)) and J. OHWI (11).

References: (1) Bot. Mus. Leaf. Harv. Univ. 12 (1946) 149-172, 179-182. (2) Kew Bull. (1946) 5-29. (3) Blumea 3 (1938) 62-94; *ibid.* (1939) 267-371; *ibid.* (1940) 481-582; *ibid.* 5 (1943) 339-410; *ibid.* (1945) 689-691; J. Arn. Arb. 29 (1948) 414-418. (4) Blumea 4 (1941) 482-492. (5) Rec. trav. bot. néerl. 40 (1943) 1-391. (6) Blumea 1 (1935) 241-294; Bull. Jard. Bot. Botz III, 16 (1939) 139-235. (7) Bot. Jahrb. 74 (1949) 375-509. (8) Mém. Mus. Nat. Hist. Natur. n.s. 24 (1948) 111-181; Bull. Mus. Hist. Natur. II, 19 (1947) 205-212, 294-301; *ibid.* 362-369, 409-410; *ibid.* II, 20 (1948) 190-197, 296-303, 381-382; Not. Syst. 13 (1948) 212-229, 230-254; Bull. Soc. Bot. France 94 (1947) 31-49; *ibid.* 95 (1948) 211-216. (9) Bull. Tokyo Sci. Mus. no 22 (1948) 1-43. (10) Tokyo Bot. Mag. (1941-1943) *passim*. (11) Bull. Tokyo Sci. Mus. no 18 (1947) 1-16. (12) Blumea 2 (1936) 119-220. (13) *ibid.* 4 (1941) 359-480. (14) Bibl. Bot. Heft 111 (1934). (15) Bot. Jahrb. 72 (1942) 207-269. (16) *ibid.* 71 (1941) 138-168. (17) *ibid.* p. 375-510.

108. *A note on recent descriptive studies of Malaysian Pteridophytes*

The phytography of Malaysian Pteridophytes has received contributions from numerous botanists, whose chief occupation was the study of Phanerogams. Besides, some authors made Pteridophytes of Malaysia one of their chief subjects of research.

Among 19th century descriptions of Ferns were mentioned BLUME's work (his *Enumeratio* of 1827 and the 2nd volume of *Flora Javae*, cf. § 47), and DE VRIESE's monograph of *Marattiaceae* (§ 48). F. JUNGHUHN gave a list of publications on Javan cryptogams in his *Java* (1). VAN DEN BOSCH wrote on *Hymenophyllaceae* (1861), and there are considerable contributions in MIQUEL's *Annales* by G. METTENIUS (1863–1869) and M. KUHN (1869). BECCARI included in his *Malesia* a review of Ferns and *Lycopodiaceae* of Borneo and New Guinea (V. CESATI, 1886).

HOOKE's *Species Filicum* (1846–'64, with J. G. BAKER *Synopsis Filicum*, 1865, '68, 2nd ed. 1874) and J. G. BAKER's *Handbook of Fern Allies* (1887) are critical compilations which included all knowledge assembled so far.

RACIBORSKI (§ 71), CHRIST, VAN ALDERWERELT (§ 75), and COPELAND (§ 84) supplied by their work many valuable data to C. A. BACKER and O. POSTHUMUS when they were composing their excellent *Varenflora voor Java* (1939) which contained also the results of their many years of research into the Javan Ferns. They listed the most important literature. O. POSTHUMUS (§ 105, 110) is to be regarded as one of the leading pteridologists of Malaysia in the first half of the 20th century. Among his various papers I select *Malaysian Fern Studies I–III* (1). On occasion of his evaluation of the stem anatomy in *Polypodiaceae* (2), he added a useful bibliography.

A. H. G. ALSTON (§ 21) monographed *Selaginella* (3).

The reader is referred for further information to F. VERDOORN's *Manual of Pteridology* (1938), C. CHRISTENSEN's *Index Filicum* (1905–'34), and E. B. COPELAND's *Genera Filicum* (1947).

*References:* (1) Verh. Kon. Akad. Wet., sect. 2, 36 (1937) 1–67; *ibid.* 37 (1938) 1–35; Ann. Jard. Bot. Btzig, hors série (2603 = 1943) 35–113. (2) Rec. trav. bot. néerl. 33 (1936) 775–802. (3) Bull. Jard. Bot. Btzig III, 13 (1935) 432–442; *ibid.* 14 (1937) 175–186; 16 (1940) 343–350.

109. *Useful plants described*

The study on economic plants is older than that of taxonomy; it may be said that taxonomy received a main stimulus for its development from the necessities of defining the status, and of furnishing a means of recognition, when economic properties to be found in certain plants had to be recorded and made publicly available. With the emancipation of taxonomy, economic botanists were no longer required to occupy themselves with phytography; a scientific name for the plant under discussion represented an efficient directive when its identity was to be established.

When dealing with the flora of a well-searched region, this practice proved to be satisfactory. Articles discussing the economic value of some species might be used to full advantage as long as the name of the plant under consideration could be, and was, given correctly. In regions of which the flora had been studied to a limited extent, no such direct approach was possible and the economic botanist of the present saw himself not infrequently obliged to describe his plants 'botanically', in order to make clear where his data were applicable or, otherwise, to call in the assistance of professional phytographers. The endeavour of the economic botanist to execute the required phytography personally often fell short of its aim and, for example, much of the work of A. CHEVALIER on the economic plants of Indo-China (1) is practically useless as it will for ever remain uncertain which plant species was referred to. CHEVALIER failed, certainly not in all of his work but in some instances, to make his subjects recognizable. A far more serious case is that of CH. CREVOST and CH. LEMARIÉ who, dealing with the economic botany of the same region, supplied erroneous names (2).

Quite the opposite is demonstrated in J. J. OCHSE's books on vegetables and fruits *Fruits and Fruitculture in the Dutch East Indies and Vegetables in the Dutch East Indies* (§ 99). Here meticulous descriptions (by R. C. BAKHUIZEN VAN DEN BRINK Sr), and drawings, accompany the sections of the text dealing with practical uses. This method supplies the reader, in addition, instantly with the data to identify any edible plant he may meet with.

When discussing the phytography of the 19th century, I have repeatedly pointed to economic botany, cf. HORSFIELD (§ 40), DE VRIESE (§ 48), HASSKARL (§ 53), BURCK (§ 67), KOORDERS (§§ 69, 73), GRESHOFF (§ 74), TSCHIRCH (§ 77), WARBURG (§ 78), BROWN (§ 83), RIDLEY (§§ 87, 88), BURKILL (§ 90), BACKER (§ 100), and in various other paragraphs.

The first effort to write a comprehensive work on all the economic plants in the Netherlands East Indies had been made by A. H. BISSCHOP GREVELINK in his *Planten van Nederlandsch-Indië bruikbaar voor handel, nijverheid en geneeskunde* (1883), which was followed by a *Nieuw Plantkundig woordenboek voor Nederlandsch-Indië* by F. S. A. DE CLERCQ (ed. M. GRESHOFF 1909, § 74).

A luxurious work on some useful or decorative plants in Java was made of 36 coloured plates, *Fleurs, fruits et feuillages choisis etc.* bij Mrs B. HOOLA VAN NOOTEN-DEN DOLDER (1864).

The main works on economic botany in Malaysia of the 20th century are at present W. H. BROWN's *Minor products* (§ 83), I. H. BURKILL's *Dictionary* (§ 90), J. J. OCHSE's books on fruits and vegetables mentioned above, and K. HEYNE's *De nuttige planten van Nederlandsch Indië*.

HEYNE was Head of the Museum for Economic Botany at Buitenzorg (1906–'27), an institution entirely built and maintained through his devotion. The exhaustive compilation of all data obtained previously was only a minor part of his work. Collectors travelled for years (H. A. GUS-

DORF 1913-'14, C. W. GRASHOFF 1915-'16, V. M. A. BEGUIN 1919-'23, also ACHMAD, BRUINIER, and DUMAS) on his behalf in the Archipelago assembling specimens alleged to be of economic importance; HEYNE himself had a small experimental garden near his office. The results were embodied in *De nuttige planten* (3).

HEYNE's texts lack the literary qualities of BURKILL's. His book is typographically less attractive, his articles have less direct appeal to the reader. On the other hand, HEYNE's sources were crude and unsifted; BURKILL, writing ten years later on the products of a much smaller area, with HEYNE's work at his disposal, had no mean advantage. Moreover, if HEYNE seems to have burdened his chapters now and then with too much detail, it may be advanced, that a surprisingly large amount of these details have proved to be useful, and having them arranged and available in one comprehensive work means that they are not forgotten, a fate that would inevitably await many facts now easily accessible in *De nuttige planten*. HEYNE's compilation is, in addition, critical and conclusions are advanced with caution. *De nuttige planten* will always remain an authoritative source and an excellent point of vantage when deciding on the direction of new research. A verbatim new edition is shortly to appear.

HEYNE was fortunate in having the voluntary assistance of some contemporaries. C. A. BACKER helped him with the identification of his specimens and wrote practically the chapter on the grasses; C. VAN OVEREEM assisted in the Cryptogams.

A valuable aid in identifying timber trees when only sterile material is available is F. H. ENDERT's *Geslachtstabellen voor Ned.-Indische Boomsoorten naar vegetatieve kenmerken* (1928).

I have mentioned before BACKER's work (§ 100) on the weeds of the sugarcane fields (vol. 7 of the *Handboek ten dienste van de Suikerrietcultuur*) and, in collaboration with D. F. VAN SLOOTEN, on the weeds of the tea plantations (cf. § 100).

The necessity of distinguishing among cultivated sugarcane induced J. JESWIET c.s. (in particular assisted by BACKER), to draft meticulous descriptions of the varieties (4) accompanied by some general studies in *Saccharum*.

Here belongs also *De Oost-Indische Cultures* by K. W. VAN GORKOM (1884, new edition by H. C. PRINSEN GEERLIGS, 1917-1919). Mention has to be made of P. J. S. CRAMER's descriptive work (5) in the genus *Coffea* (1913) in connection with his investigation of the history of its introduction and its selection.

Horticulture was served by DAKKUS in his books on Orchids (cf. § 97) and more still by M. L. A. BRUGEMAN in his *Sierboomen* (1938) and the charmingly illustrated *Indisch Tuinboek* (1939).

In the Netherlands, the study of Malaysian economic botany is largely centred in the 'Indisch Instituut' (formerly 'Koloniaal Museum', later 'Koloniaal Instituut') which issued a *Beschrijvende catalogus* and a large series of *Bulletins*.

References: (1) Bull. Écon. Indo-Chine, *passim*. (2) CREVOST & LEMARIÉ, Catalogue des produits de

l'Indo-Chine 5 vols (1917-1935) (3) HEYNE, *De nuttige planten van Ned. Ind.* 1st ed. (1913-1917), repr. vol. 1 (1922), 2nd ed. (1927). (4) Meded. Proefstat. Java Suikerind. vol. 6, pt 5, 8, 13 (1916), cntd *ibid.* Landbouwkundige serie (1917) nos 3, 8, 12, 17; *ibid.* (1918) 5; *ibid.* (1920) 4, 9; *ibid.* (1925) 12, 13; *ibid.* (1926) 16, 17; *ibid.* (1928) 19. (5) Meded. Dep. Landbouw 11 (1913).

#### 110. Subjects not discussed

In this short history, I have advised repeatedly that no attempt could be made for an exhaustive study of any of the subjects under discussion. It seems advisable to point out at this moment that a considerable number of facts and events, influencing the course of development of Malaysian phytophraphy, have not been touched on at all.

I mention, therefore, in passing the 'Nederlandsch-Indische Vereeniging tot Natuurbescherming', founded in 1912, mainly by the initiative of KOORDERS (§ 73) and DAMMERMAN (§ 105). The results of this Society for Nature Protection have been so considerable, and the opportunities so numerous, to investigate what would have disappeared without trace, had it not been for its interference, that phytophraphy has benefited, and will continue to benefit, greatly. In 1918, the Society edited the first series of an *Album* which consisted of plates with accompanying text, somewhat in the style of KARSTEN and SCHENCK's *Vegetationsbilder*. In 1939 appeared *3 jaren Indisch Natuurleven*, a most informative, and beautifully illustrated, commemorative volume.

The scientific research of the protected areas is entrusted to the Buitenzorg Botanic Gardens; the organisation and management to the Forestry Service.

Another subject not discussed is palaeobotany, the phytophraphy of extinct and fossilized plants. The reader will find a survey of the research done and a literature list in POSTHUMUS's (§§ 100, 108, 111) *On palaeobotanical investigations in the Dutch East Indies and adjacent regions* (1).

There are also the methods of collecting and of preserving specimens in the field, the methods of preserving, mounting, and arranging specimens in a herbarium, and the methods of labelling, either in the field or in the herbarium. The invention of the 'Wardian Case', by N. B. WARD, in 1836, which opened the possibility of bringing hundreds of species, hitherto untransportable, from the tropics into institutes where phytophraphers described them, might well have received some consideration. These, and many other points I cannot elaborate now but I wish that the reader should be aware that phytophraphy is a basic science, an essential to all botany; that it is, therefore, connected with all branches of plant science.

References: (1) Bull. Jard. Bot. Btzig III, 10 (1929) 374-384.

#### 111. The effects of the 2nd World War

The second World War has left a lasting imprint on Malaysian phytophraphy. First of all, phyto-

rappers of standing and of promise met with an early death as one of its consequences. I refer here only to R. C. BAKHUIZEN VAN DEN BRINK SR (§§ 2, 99, 109), P. BUWALDA, who had roused high hopes by his revision of Malaysian *Umbelliferae* (1) and his forest explorations (§ 104), P. J. EYMA, the industrious collector and traveller in Celebes (1937), Ceram (1937–38) and New Guinea (1939), O. POSTHUMUS, a leader in the field of pteridology (§§ 100, 105, 108), and C. F. SYMINGTON, whose *Manual of Dipterocarps* (§ 92) testifies of his skill; they died in consequence of the war in Malaysia.

It is beyond the scope of this essay to mention the many able amateur-collectors who perished during this war in Malaysia or in continental Asia; their memories are kept living in the first volume of this work.

In the Netherlands, *Flora Malesiana* lost its prominent cyperologist H. UITTIEN and its most prominent promoter B. H. DANSER who had agreed to share the editorship of this work. In Germany, the death of L. DIELS prematurely finished the career of, possibly, the ablest authority on the New Guinean flora.

The material losses were heavy, both in Europe and in Malaysia. Irreparable damage was done to the huge Berlin-Dahlem collections (3) resulting in the loss of many numerous type specimens (§ 106); less severe losses were inflicted to the Vienna and British Museum collections. In Malaysia, losses were serious at Sandakan (§ 101), Sarawak (§ 102) and at Kuala Lumpur (§ 92). The destruction of the Manila Herbarium is a heavy blow to phyto-graphy (§§ 81, 85); fortunately the wise policy of a generous distribution of duplicates had been long adopted by MERRILL, and the labour to assemble the big Philippine collections has not been in vain. Nevertheless, a number of type specimens is irretrievably lost. In the aftermath of the war some damage was done at Buitenzorg resulting in the loss (2) of some very valuable East Malaysian collections of EYMA's (§ 103, 104, 106).

In addition, the progress of phyto-graphy halted in many centres during the war years, partly through the absence of scientists for reasons of war, and partly because the issue of botanical journals was almost completely discontinued. In Germany, the Netherlands, and in the United States work on the Malaysian flora was continued, however (cf. §§ 99–106).

*References:* (1) BUWALDA, The *Umbelliferae* of

the Netherlands Indies (1925). (2) Fl. Mal. Bull. no 5 (1949) 130–131. (3) Kew Bull. (1949) 172–175.

## 112. Conclusions and prospects

The account in the preceding pages has made it clear, I believe, that Malaysian plant description is contained in a mass of literature, from standard works which may be consulted at every botanical institute to small notes hidden in the few remaining copies of rare periodicals. Only an exhaustive bibliography can give satisfactory and detailed information concerning the work done in its entirety. A book of that nature is urgently required.

A practical conclusion, which may be derived even from this short history, is that the majority of the phyto-graphical studies have been local, i.e. the flora or plant groups were described only as occurring in a limited area or in one island. Malaysia is essentially a homogeneous well-defined plant geographical region; phyto-graphical research ought, first of all, to be directed towards revisions of *taxa* in the whole of Malaysia.

VAN STEENIS has demonstrated that in the progress of phyto-graphy in the tropics—which culminates in the issue of a general Flora—a clearly marked and fixed sequence of stages can be observed. Malaysian phyto-graphy, he found to have entered the 5th stage *viz* the composition of a critical general Flora (Vakbl. Biol. 29 (1949) 27).

For Java a local Flora is at present in course of publication (§ 100) and at Singapore a new local Flora of the Malay Peninsula is planned (cf. § 88). These local Floras will prove to be of great use and to advance phyto-graphy considerably. Nevertheless, they are historically and scientifically premature (belonging to stage 6!) and they will inevitably suffer from shortcomings avoidable when a general Flora of the whole of Malaysia could have been made to a guide and a source of information.

Our present *Flora Malesiana* is the brightest hope of future Malaysian phyto-graphy. Many have joined in its writing; work is done in the main, and in many of the smaller, Herbaria of the world and there is whole-hearted support and enthusiastic international co-operation.

The profound change in the Government of Malaysia will affect phyto-graphy, let us hope, not unfavourably. The words of JOANNIS COMMELIN (1701) may conclude this survey of the history of Malaysian phyto-graphy:

(transl.) "It is certain, however, that this Science, like all Sciences, flourished sometimes more and sometimes less, all in accordance with the inclination of Rulers and the Favour of Government."

"Het blijft echter zeeker, dat deeze Wetenschap, gelijk alle andere, nu meerder dan minder heeft gebloeit, na dat de toestand der heerschappijen en neigingen der Oppermachten dezelve begonstiden."

*Acknowledgments.* I am greatly indebted to Dr C. G. G. J. VAN STEENIS who spared neither his criticism nor his constructive help, much to the betterment of my work. He supplied me with the portraits from his iconotheca. Mr E. J. H. CORNER read the text. Dr E. D. MERRILL sent the photo-

graph of the Manila Herbarium, Mr R. E. HOLTUM that of Singapore. I wish to thank also the Staffs of the Buitenzorg and the Leyden Libraries who assisted me in all respects and walked cheerfully many miles in search of desired samples of phyto-graphy.

*Main works of reference.*—BACKER, Verklarend Wordenboek van wetenschappelijke plantennamen (1936).—BOHNENSIEG & BURCK *c.s.*, Repertorium ann. lit. bot. period. 1-8 (1872-1886).—COMMELINUS, C., Flora Malabarica sive Horti Malabarici Catalogus (1696).—DRYANDER, Catalogus bibliothecae hist. nat. J. BANKS 5 vols (1796-1800).—EKAMA, Catalogue de la Bibliothèque, Fondation Teyler 2 vols (1885-1903, 2nd vol. by BOHNENSIEG).—HOOYKAAS *c.s.*, Repertorium op de koloniale literatuur 2 vols and 7 suppl. (1877-1930).—JACKSON, Guide to the literature of Botany (1881).—JACKSON & HOOKER, J. D., Index Kewensis 2 vols (1895, names till 1885), 10 supplements (1906-1947, names till 1940).—JUNGHUHN, Literatuur over de Flora van Java, in Java, 2nd ed. (1853) 127-146.—LITH, VAN DER, *c.s.* Encyclopaedie van Nederlandsch-Indië, 1st ed., 4 vols (1896-1905); 2nd ed., by PAULUS *c.s.*, 4 vols (1917-1921); suppl. vols 5-9<sup>2</sup>, by STIBBE *c.s.*, (1927-1940).—MERRILL, Bibliography of the Botany of Borneo in Sarawak Museum Journ. 2 (1915) 99-136; Bibliography of Philippine Botany in Enum. Philipp. Flow. Plants

4 (1926) 155-239.—MERRILL and WALKER, Bibliography of Eastern Asiatic Botany (1938); Botanical Bibliography of the Islands of the Pacific in Contr. U.S. Nat. Herb. 30 (1947).—PRITZEL, Thesaurus literaturae botanicae ed. 2 (1872).—REHDER, The Bradley Bibliography 5 vols (1911-1918), woody plants till 1900.—STAPP, Index Londinensis 6 vols (1929-1931), 2 suppl. vols by WORSDELL (1941, containing pictures of 1921-1935).—STEENIS, Annotated publications on or of importance to the Malaysian Flora in Fl. Mal. Bull. (1947 →).—STEENIS-KRUSEMAN, Cyclopaedia of Malaysian Botanical collections and collectors, Fl. Mal. ser. I, vol. 1, in the press.—WING EASTON, Inventaris techn. en wetensch. periodieken in Nederl. bibliotheken 2 vols (1935), issues till 1934.—WITTSTEIN, Etymologisch-botanisches Handwörterbuch (1856).—WOODWARD, H. & BRITTEN, Catalogue of the Library of the British Museum 5 vols (1903-1915); WOODWARD, B. B. *c.s.* Catalogue of the British Museum (Natural History) cntd vol. 6-8 (1922-1940).

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# KEYS FOR IDENTIFYING MALAYSIAN PLANTS

The Flora Malesiana is not preceded by a general key enabling one to identify any unknown native or wild plant to the family or genus to which it belongs. This is certainly a serious lack and presents a formidable handicap to inexperienced taxonomists in rapid naming current collections.

However, there are several forcing arguments for omitting—at present—such an attempt which in itself would present no facile task, and could be accomplished only by a taxonomist thoroughly acquainted with the Malaysian flora. One could of course use some world key as a basis and cut out the entries leading to genera or families not represented in the Malaysian flora, but this procedure would be unsatisfactory, specially as these world keys make little use of vegetative characters; the latter appear to me very important specially in the earlier forks of the keys.

The difficulty in compiling a general key at the start of Flora Malesiana is mainly caused by the numerous exceptions to current interpretation and definitions of taxonal characters. These become only known when the taxa concerned have been thoroughly revised. Some random chosen examples will illustrate this: Leaves in *Ilex* are generally accepted to be spirally arranged, but MERRILL recently described some Bornean species with opposite leaves. The same author described a *Dichapetalum* with entire petals, though hitherto the bifid or emarginate petals were accepted to be characteristic of the genus. RIDLEY described an other species of this genus with 4-merous flowers. In *Leea* a species has been described with tetramerous flowers, in *Erythralpalum* one with 3 stamens without staminodes, and in *Cyrtandropsis* one with unisexual flowers. Cauliflory has been added as an extension of the generic characters of *Radermachera*. In *Thymelaeaceae-Gonystylloideae* one representative has been found to possess practically opposite leaves and an annular corolla. A *Uvaria* has been described with distinctly sympetalous corolla. One *Phytocrene* has its ♂ flowers arranged in solitary axillary heads. *Mastixiodendron*, the only representative of the Cornaceae with interpetiolar stipules, has been removed to the Rubiaceae. *Oleaceae*, generally defined in Malaysia with opposite leaves and two stamens show sometimes alternate leaves and in Javan *Olea* I found not rarely 3-4 anthers. Recently a *Quercus* was described with leaves in whorls of three. In *Premna* herbaceous species were recorded. In *Pentaphragma* some species possess a gamopetalous corolla. *Myricaceae* and *Celastraceae*, mostly accepted as exstipular have proved to possess stipules occasionally. In the *Myrtaceae* several aberrant genera have been discovered with few or only one basifixed seed. All these characters tend to extend the generic and family diagnoses and should be accounted for in general keys.

Another serious difficulty is that a number of genera have been referred to families to which they apparently do not belong; their descriptions are not seldom inadequate.

Finally, revisions show that quite a number of genera, either unknown to science or not yet recorded from the Malaysian flora occur within its boundary.

These arguments serve to demonstrate, that it is inadvisable to make a premature attempt towards a general key to the genera, that it would be hardly possible to make it reliable, and impossible to make it complete.

For the aim of referring specimens to a family there are some sources which have often yielded good results. They are the following:

BACKER, C. A.: *Schoolfiora voor Java*. Weltevreden 1911, p. vii-cii.—Contains an original key to Javanese plants which has proved to be often useful for regions outside Java, though based on characters strictly belonging to the Javanese species.—In Dutch.

—: *Onkruidflora der Javasche suikerrietgronden*. Handboek ten dienste van de Suikerriet-cultuur en de rietsuikerfabricage op Java. Vol. 7. Soerabaja 1934, p. LXXXIII-LXXXVII.—Key to c. 750 weeds of sugarcane fields in Java.—In Dutch.

ENDERT, F. H.: *Geslachtstabellen voor Nederlandsch-Indische boomsoorten naar vegetatieve kenmerken*. Thesis, Wageningen, 1928. Appeared also as 'Mededelingen van het Boschbouwproefstation te Buitenzorg' vol. 20, 1928, 242 pp. (Commun. For. Res. Institute Buitenzorg).—Key to the genera containing trees in Indonesia based on vegetative characters with the aid of a hand-lens. Of paramount value. Incomplete for Papuan genera.—In Dutch.

GAGNEPAIN, F.: *Clef analytique et synoptique des familles de plantes vasculaires décrites dans la Flora générale de l'Indo-Chine*. Supplément à la Flore générale de l'Indo-Chine.—Private issue, Paris 1922, 34 pp.. Published in a slightly revised edition in the said Flora, tome préliminaire, Paris 1943, p. 50-89.

HUTCHINSON, J.: *Families of flowering plants*. Vol. 1, Dicotyledones, London 1926, p. 9-80. Vol. 2, Monocotyledones, London 1934, p. 9-25.—An exceedingly useful, general key covering all genera.

MERRILL, E. D.: *A flora of Manila*. Manila 1912, p. 33-45.—A small key of a local flora, still original and not without merits for identifying specimens outside the area it covers.

ST JOHN, H. & F. R. FOSBERG: *Identification of Hawaiian plants*. Part 1, Dicotyledons. University of Hawaii, Occas. Pap. no 36, 1938, p. 4-25; part 2, Gymnosperms & Monocotyledons, op. cit. no 41, 1942, p. 5-13.—Intended only for Hawaii; the second part gives keys as far as the genera.

THONNER, F.: *Anleitung zum Bestimmen der Familien der Blütenpflanzen*. 2nd edition, 1917, Berlin, 280 pp.—Originally based on a general key to African plants but extended to all flowering plants.

## DATES OF PUBLICATION

Priority of publication is internationally accepted as the basic principle of the 'Rules of Botanical Nomenclature'.

This has emphasized to a marked degree the importance of determining accurately the exact time when novelties are placed before the scientific public.

The Rules state:—*that the date of publication is the time that the printed matter became available by distribution (sale, exchange, or gift). In the absence of proof establishing some other date the one appearing in the printed matter must be accepted as correct. When separates from periodicals or other works offered for sale are issued in advance, the date on the separate is accepted as the date of effective publication unless there is evidence that it is erroneous.*

It becomes more and more apparent that hardly any book or journal is adequately dated as to detailed information on the precise day and month. Further it has become obvious that the date printed on the title-page of many works is incorrect. According to J. H. BARNHART (Torreya 6, 1906, 97) 'few even of experienced botanists realize what a large percentage of the literature of our science is labeled with misleading dates.'

It is unfortunate, though unavoidable, that even generic names may depend on these detail data. A curious example is that of the genera *Lowia* SCORT. and *Orchidantha* N. E. BROWN which are generally considered congeneric. Both were published in October 1886. According to the Rules it seemed that the combined genus should be called *Lowia* as BAKER treated them as congeneric for the first time under that name. However, in Index Kewensis Suppl. 2 it is stated that the issue of the Nuovo Giorn. Bot. Ital. in which *Lowia* was published should be dated October 25 and the number of Gardeners' Chronicle in which *Orchidantha* was described was issued October 23, by which *Orchidantha* gains priority.

Unfortunately also well-known names of widely distributed plants may likewise be involved; one example out of many is that of *Batatas crassicaulis* BENTH. which was described on page 134 of the Botany Report of the Voyage of the 'Sulphur'; this Report was issued in instalments and this page belonged to one which was published in April 1845 (see Mr STEARN's data under BENTHAM) and not in 1844 as generally accepted; therefore it must have been published later than the treatment of the *Convolvulaceae* by CHOISY in DE CANDOLLE's Prodrum vol. 9 (publ. early Jan. 1845), who described the same species as *Ipomoea fistulosa* MART. BENTHAM also mentions on page 133 of his Report that he knew of the contents of CHOISY's work in the Prodrum.

Another case is that of the Combretaceous generic names *Getonia* ROXB. and *Calycopteris* LAMARCK, mentioned by EXELL (cf. p. 584). He says:—'The question of priority between *Calycopteris* LAMK and *Getonia* ROXB. has long been a cause of instability in the nomenclature of this genus. LAMARCK's tab. 357 in his 'Illustrations des Genres' is still of uncertain date but was published not later than 1796 and probably about 1793-4. This plate seems to validate the genus although the corresponding text was not published until 1819. As long as ROXBURGH's *Getonia* appeared to have the firm date of 1795 it still seemed better to accept this name in view of the uncertainty about the date of *Calycopteris*; but W. T. STEARN now assures me that he has conclusive evidence (cf. p. ccx) that ROXBURGH's 'Plants of the Coast of Coromandel' was published in parts and that *Getonia* did not appear until 1798, later than any possible date for *Calycopteris*.'

Fortunately these are cases which could be settled with some degree of finality.

There are still several important works on Malaysian botany of which we lack evidence on publication dates, e.g. BLUME's 'Rumphia'. And although we can 'deal' with these works, in accepting the title-page date as the exact one for the present, the outcome of future bibliographical research remains a persistent, severe menace to stability of botanical nomenclature.

Whether this will, in the long run, be tolerable to botany or, whether it will assume gradually such unreasonable proportions that botanists, internationally, will be forced to a decision to accept '*data operum publicationis conservanda*' for the final dating of a limited number of critical works, is a question which will possibly come under consideration at some future date. Having to juggle with generic names as in the case of *Getonia-Calycopteris* is ridiculous, both for outsiders and insiders. Judging from the appreciable size of the still very incomplete account of listed works in this chapter, there will be no end to this sort of thing for some time to come.

From the standpoint of a bibliographer this is all very interesting, and I have a great admiration for the tenacious and careful way in which a handful of natural history bibliographers



have attempted to remedy this unfortunate state of affairs; as a result of their researches into dates of publication thousands of botanical names can now be dated with precision.

But let botanists not forget that for their aim bibliography is merely a tool. *Botanical science* should be freed, as much as possible, from all this bibliographical matter, *botanical nomenclature* should be stabilized as much and as soon as possible in a reasonable and acceptable way, and *taxonomists* should not be suffocated by unnecessary time-consuming trifles which tend to keep them off the focus of intrinsic research.

After many considerations and much experience I have come to the opinion that it would be highly desirable to fix, once and for all, arbitrarily, by international agreement, the date to be accepted as the date of issue for certain important works concerning which there is no adequate bibliographical information available. This would manifestly be of benefit towards stabilization of botanical nomenclature and smooth the thorny path of taxonomical work.

\* \* \*

In the meantime it appeared of interest to bring together here what has been accomplished by bibliographic research and make the detailed data, as far as they have come to my knowledge, easily accessible for the use of collaborators in Flora Malesiana. Many of them are scattered in a large number of small notes in serials or are often only casually mentioned in texts dealing with other subjects and are difficult to unearth. Many new data have been added.

The ideal would be for the taxonomist to have a small book at his disposal in which all references additional to PRITZEL's basic work would be concisely compiled. This would substantially save time. In addition printed slips containing the information ought to be available for libraries, to be affixed opposite the title-page in the books concerned.

\* \* \*

The sources for getting the detailed information on dates of publication are very different, but all should be carefully considered on their merits. Hardly any single source is watertight and is mostly only exact to a certain degree. The definition of the 'date of publication' in the Rules is clear as to its meaning, and simple in its expression, but the practice of publication and distribution of printed matter is liable to be irregular.

In a case like that of *Orchidantha*, antedating *Lowia* just by a week-end, mentioned above, it could so easily happen that the regular day of distribution of the Gardeners' Chronicle might be postponed a few days on account of a national holiday, a fire in the buildings or some other calamity. Illness of an editor or other key people in the printer's office can hold up distribution of already printed matter. In our era it seems that strikes, getting more and more popular, may add to the confusion. Also after the printed matter has left the publishing agent, the date of publication is left to the mercy of the postal authorities who in turn may be temporarily unable to distribute the printed matter through accidental calamities. This shows that the fixing of the required 'date of publication' is, and will always remain, arbitrary, and that the evidence looked for is mostly only true to some degree of precision.

It is, according to Mr W. T. STEARN, highly desirable that *at least two, preferably 3, independent sources should agree with each other*. This can easily be shown from the following example of an often used source of information: Given a work of which each volume bears a year of issue on the title-page. Let us suppose that there is reason to think that it has been published in instalments. Let us further assume that a copy is located with the original covers preserved, and that each of these parts has been dated separately. Superficially the evidence is conclusive. Experience learns, however, that many works were issued in parts but that the parts were not issued separately or punctually in accordance with the dates printed on them. Sometimes, also, for economy, covers were printed in bulk in advance for such works and were carelessly used, see for instance DESFONTAINES, Fl. Atl., MIQUEL, Ann. Lugd. Bat. In other cases the actual distribution of the fascicles was very irregular and dispatch was sometimes retarded to combine the sending of more than one part. Early French expedition reports are notorious in this respect and their date of 'becoming available' is frequently very difficult to settle by means of the original wrappers only. If, however, there is *other* contemporaneous sustaining evidence from reviews, receipts, or announcements the evidence gains considerably in importance.

In some instances the printers were careless in mixing *a posteriori* sheets of different editions so that individual copies have different contents; cf. for example LAMBERT's work on *Pinus*.

Other papers already in print or even distributed have been recalled as ELLIOTT's Sketch of the botany of S. Carolina.

A remarkable case is that of Sessé & Mocino, *Flora Mexicana*, of which there are 2 editions which overlap each other, part of the differently paged 2nd edition (onwards of *Myrtus racemosa*) having priority over the first one.

Trustworthy evidence is often obtained from libraries, printers' files, or other archives which have kept records of the date of incoming and outgoing printed matter.

Good evidence is generally obtained from book reviews, either in botanical journals, accession accounts of learned societies, and news or announcements from booksellers.

Less trustworthy is the evidence obtained from citations in botanical papers, because it is not always known if the data were derived from a regularly distributed printed copy, from a personal letter containing the information, or perhaps from proof sheets in course of publication, which were often mutually interchanged between contributors or writers of standard works or befriended botanists, *cf.* for instance *sub* BARTON and RICHARD (*Mém. Rub.*). Also advance distribution of loose sheets (*Druckbogen, feuilles*) may have taken place to explain such citations. In the case of SCHLECHTER's work on *Orchidaceae* of New Guinea (in FEDDE's *Rep. Beih.* 1) the separate sheets are provided with the date when they were 'erschienen'; it may be that this has been done to secure priority and accept the date of actual printing of these sheets, but I am unaware (and doubt very much) whether these sheets were actually distributed. And it is the latter procedure which would validate these dates. In Nova Guinea the separate articles were often provided with a date on which they have been set up in print ('gedruckt') and the publishers have wrongly translated this by 'publié'.

*General bibliographies* in which dates of publication have been found include:

1872. *Thesaurus literaturae botanicae* by G. A. PRITZEL.

1873-1874. *Nomenclator botanicus: nominum ad finem anni 1858 publici juris factum* by L. PFEIFFER.

1881. *Guide to the literature of botany, etc.* by B. D. JACKSON.

1891-1898. *Revisio generum plantarum* by O. KUNTZE.—This contains, unfortunately, many errors and should not be uncritically followed.

1895-*hodie*. *Index Kewensis, etc.* by J. D. HOOKER, B. D. JACKSON, *etc. etc.*

1903-1940. *Catalogue of the books, manuscripts, maps, and drawings in the British Museum (Nat. Hist.)* by B. B. WOODWARD.

1911-1918. *Bradley Bibliography* by A. REHDER.

1921. *A contribution to the bibliography of the botany of Borneo, etc.* by E. D. MERRILL (*Sarawak Mus. Journ.* 2, pt 2, 1915, 99-136).

1926. *A bibliography of Philippine botany* by E. D. MERRILL (*Enum. Philip. Flow. Plants* 4, 1926, 155-239).

1929-1941. *Index Londinensis* by O. STAPP (ed.).

1938. *A bibliography of Eastern Asiatic botany* by E. D. MERRILL & E. H. WALKER.

1947. *A botanical bibliography of the islands of the Pacific* by E. D. MERRILL & E. H. WALKER (*Contr. U.S. Nat. Herb.* 30, pt 1, 404 pp.).

1951-1952. *Die botanische Buchillustration, ihre Geschichte und Bibliographie* by C. NISSEN.

*Serials* which are devoted to bibliography or contain regular contributions on the subject are among others:

1818. *Flora (Bot. Zeitung)* (reviews and announcements).

1863-1942. *Journal of Botany* (London).

1887-*hodie*. *Kew Bulletin*.

1919-*hodie*. *Journal of the Arnold Arboretum*.

1936-*hodie*. *Journal of the Society for the Bibliography of Natural History*.<sup>1</sup>

1947-*hodie*. *Flora Malesiana Bulletin*.

(1) This periodical contains a catalogue of papers concerning the dates of publication of natural history books by F. J. GRIFFIN, C. D. SHERBORN and H. S. MARSHALL in vol. 1 (1936) 1-30, with the first supplement by F. J. GRIFFIN in vol. 2 (1943) 1-18 and the second supplement by W. T. STEARN and A. C. TOWNSEND in vol. 3 (1954) 5-12.

Besides there are several other library catalogues, some German Bücherlexicons (e.g. HEIN-SIUS's, later HINRICH's, and KAYSER's), the Bibliographie de la France, booksellers's catalogues (e.g. HINRICH's, Verzeichnis der Bücher, etc., and FRIEDLÄNDER, Naturae Novitates), the Nieuwsblad van de Boekhandel, and similar publications in which very useful information may be found.

I have to express my gratitude to Mr W. T. STEARN, British Museum (Nat. Hist.), Botany Department, who assisted in the most generous way in the present endeavour and who contributed to it personally by providing the dates of publication of ENGLER & PRANTL's 'Die Natürlichen Pflanzenfamilien', of ROXBURGH's 'Plants of the Coast of Coromandel', and many other works. I have also to thank Mr H. S. MARSHALL, librarian of the Royal Botanic Gardens, Kew, for valuable assistance and the liberal way in which he put his file at my disposal. Dr H. C. D. DE WIT, of Flora Malesiana Foundation, gave me a copy of his notes on BLUME's 'Rumphia' and the 'Pflanzenfamilien'. Dr R. LORENTZ, librarian of the unique Teyler's Library, Haarlem, assisted materially in unearthing data on BLUME's 'Rumphia' and VON MARTIUS's 'Genera et species palmarum'.

M. J. VAN STEENIS-KRUSEMAN

## LIST OF WORKS AND SERIALS

In the following concise account neither pre-Linnean literature has been taken into consideration, nor literature exclusively dealing with cryptogams.

In most cases the evidence from book reviews, etc., points to the latest date on which the work was published.

Books, pamphlets, and serials have been merged into one alphabetical list; anonymous journals have been entered by the alphabet of the first key word, for example 'La Naturaleza' under 'Naturaleza'; works under one author's name have been arranged chronologically.

In general only the main sources from which the dates have been derived are mentioned, but not the complete detailed evidence for each plate or fascicle separately.

Of some works where the information would occupy several printed pages, but which are of minor importance for Flora Malesiana, only the source is given where the details may be looked up. Cf. for example below *sub* ANDREWS, H. C., *Roses*, etc.

In the different languages the following indications are used for approximately comparable concepts: Part – fascicle – pars or fasciculus – livraison – Heft – Lieferung – entrega.

Plate – tabula – planche – Tafel.

\* \* \*

### Abhandlungen der (Königliche) Gesellschaft der Wissenschaften zu Göttingen.

See *sub* GRISEBACH, *Plantae Lorentzianae*.

### Adanson, M., *Familles des plantes*.

cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxiii.

Appeared end of 1762 or early in 1763.

### Aiton, W., *Hortus Kewensis*.

cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxiii; J. BRITTEN, *J. Bot.* 50 (1912) Suppl. 3, p. 1–16.

1st edition, 3 vols, published in 1789, probably in the first quarter.

2nd edition by W. T. AITON *f.* appeared between 1810–13, i.e. vol. 1 in 1810 (Aug.–Nov.), 2 in 1811, 3 in 1811 (prob. Oct.), 4 in 1812 and 5 in 1813 (prob. Dec.).

The 1st edition and part of the 2nd were edited by DRYANDER, the latter part of the 2nd edition by R. BROWN. Neither of the AITONS wrote the botanical descriptions of the new species published in the two editions. Authors of those were D. SOLANDER, J. DRYANDER, and R. BROWN. For the citation see *J. Bot. l.c.*

### Anales del Museo Nacional de Montevideo.

See *sub* ARECHAVELETA, *Las Gramineas Uruguayas*.

### Andrews, H. C., *Roses*; or A monograph on the genus *Rosa*, etc.

cf. E. M. TUCKER, *J. Arn. Arb.* 18 (1937) 258–260.

The dates of publication of the 122 coloured plates are listed in the cited reference. As the genus *Rosa* hardly occurs in Malaysia, the table is not copied here.

### Andrews, H. C., *Coloured engravings of Heaths*.

cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) 963–964.

Vol.	Plates	Dates
1	1–72	1794–1802
2	73–144	1802–1805
3	145–216	1805–1809
4	217–288	1810–1830

### Andrews, H. C., *Botanists' Repository*, etc.

cf. H. HARMS, *Notizbl. Berl.–Dahlem* 4 (1906) 243–245; J. BRITTEN, *J. Bot.* 54 (1916) 236–246.

Vol.	Plates	Dates
1	1-6	Nov.-Dec. 1797
	7-42	1798
	43-72	Jan.-Oct. 1799
2	73-78	Nov.-Dec. 1799
	79-128	1800
	129-144	Jan.-Mar. 1801
3	145-198	Apr.-Dec. 1801
	199-216	Jan.-Mar. 1802
4	217-270	Apr.-Dec. 1802
	271-288	Jan.-Mar. 1803
	289-342	Apr.-Dec. 1803
5	343-360	Jan.-Mar. 1804
	361-414 <sup>1</sup>	Apr.-Dec. 1804
7	415 <sup>2</sup> -432	Jan.-Mar. 1805
	433-441	Dec. 1806
	442-467	Jan.-?June 1807

Dates of later issues, beginning with part 97 deduced by BRITTEN from the Monthly Bot. Report in the Monthly Magazine. It is accepted here that the parts appeared at least in the month before their citation in the Monthly Mag.

Vol.	Part	Plates	Dates
7	97	468-472	prob. July 1807
	98	473-477	prob. Aug. 1807
	99	478-482	Oct. 1807
	100	483-487	? (not noticed)
	101	488-492	Nov. 1807
8	102	493-497	Dec. 1807
	103	498-502	Feb. 1808
	104	503-507	? (not noticed)
	105	508-512	Mar. 1808
	106	513-517	Apr. 1808
	107	518-522	May 1808
	108	523-527	June 1808
	109	528-532	July 1808
	110	533-537	Aug. 1808
	111	538-542	Nov. 1808
	9	112-116	before May 1809
(pl. 553 seq.)	117-119	568-582	before Sept. 1809
	120	583-586	prob. Nov. 1809
	10 (121-127)	587-612,	before Sept. 1810
		613-617	prob. Dec. 1810
	128	618-622	June 1811
	129	623-627	June 1811
	130	628-632	June 1811
	131	633-636	June 1811
	132	637-640	Nov. 1811
	133	641-645	Dec. 1811
	134	646-650	Mar. 1812
	135	651-654	July 1812
	136	655-659 (pl. 657 dated 1812)	
	137	660-664	prob. 1814-1815

Note. From pl. 618 onwards the dates have been ascertained from the wrappers of vol. 10.

(1) HARMS erroneously includes plate 415.  
(2) HARMS erroneously from plate 416.

Arechavaleta, J., *Las Gramineas Uruguayas* (An. Mus. Nac. Montevideo 1894-97).  
cf. L. R. PARODI, *Rev. Argent. Agron.* 3 (1936) 133.

Part	Pages	Dates
1	29-78	Feb. 1894
2	79-212	Nov. 1894
3	213-292	Sept. 1895
4	293-372	Mar. 1896
5	373-452	Aug. 1896
6	453-581	June 1897

Note. The paper was separately issued in May 1898.

Backer, C. A., *Onkruidflora der Javasche Suikerrietgronden*. 1 vol. text, 1 vol. Atlas (not yet completed).  
cf. C. G. G. J. VAN STEENIS, *Fl. Mal. Bull.* no 5 (1949) 138.

Part	Pages	Dates
1	1-196	Mar. 31, 1928
2	197-475	Mar. 30, 1930
3	476-819	Apr. 30, 1931
4	821-907	Aug. 20, 1931
5	i-lxxxvii	Feb. 22, 1934

Part	Plates	Dates
1	1-32	Mar. 1928
2	33-64	Apr. 1929
3	65-96	Sept. 1929
4	97-128	Apr. 1930
5	129-160	Dec. 1930
6	161-192	Apr. 1932
7	193-224	Oct. 1933
8	225-256	Apr. 1935
9	257-288	Mar. 1936
10	289-320	Nov. 1936
11/12	321-384	Sept. 1938
13	385-416	Nov. 1939
14	417-448	May 1940
15	449-480	Oct. 1941

Bailey, F. M., *Comprehensive catalogue of Queensland plants*.  
cf. E. D. MERRILL, *J. Bot.* 58 (1920) 200; C. T. WHITE, *Proc. R. Soc. Queensl.* 61 (1950) 112; H. S. MARSHALL, *Kew Bull.* (1953) 279.

According to WHITE the first few copies were received from the printer before Christmas 1912, but the general issue was not made until early 1913, according to MERRILL March 1913.

Baillon, H., *Histoire des plantes*.

The following has been taken from a more detailed but unpublished account by W. T. STEARN.

Vol.	Pages	Dates
1	1-88 (Renonculacées)	1866
	89-132 (Dilleniacees)	1868
	133-192 (Magnoliacees)	1868
	193-288 (Anonacees)	1868

<i>Vol.</i>	<i>Pages</i>	<i>Dates</i>	<i>Vol.</i>	<i>Pages</i>	<i>Dates</i>
	289-344 (Monimiacées)	1869		403-476 (Acanthacées;	
	345-488, i-xi (Rosacées; Index)	1869		Index)	1891
2	1-71 (Connaracées-		11	1-220 (Labiées-Ilicacées)	1891
	Mimosées)	1869		221-304 (Ebénacées-	
	73-196 (Caesalpinées)	1870		Sapotacées)	1891
	197-384 (Papilionacées)	1870		305-494 (Primulacées-	
	385-428 (Proteacées)	1870		Loranthacées;	
	429-512 (Lauracées-			Index)	1892
	Myristicacées)	1872	12	1-134 (Conifères-	
3	1-76 (Ménispermacées,			Centrolépidacées)	1892
	Berberidacées)	1871		135-334 (Graminées)	1893
	77-104 (Nymphaeacées)	1871		335-402 (Cypéracées-	'1893' but
	105-180 (Papaveracées-			Eriocaulacées)	prob. publ.
	Capparidacées)	1871			Jan. or Feb.
	181-292 (Crucifères)	1871			1894
	293-464 (Résedacées-			403-611 (Liliacées; Index)	1894
	Saxifragacées)	1872	13	1-164 (Amaryllidacées-	
	465-545 (Piperacées,			Iridacées)	1894
	Urticacées; Index)	1872		165-244 (Taccacées-	
4	1-56 (Nyctaginacées,			Rapateacées)	1894
	Phytolaccacées)	1872		245-404 (Palmiers)	1895
	57-160 (Malvacées)	1872		405-523 (Pandananées-	
	161-264 (Tiliacées-			Aracées; Index)	1895
	Ternstroemiacées)	1872	14	(never published). This volume would have	
	265-356 (Bixacées-Violacées)	1873		included Musacées, Zingibéracées and Orchida-	
	357-520 (Ochnacées,			cées; BAILLON died on 18 July 1895, leaving in-	
	Rutacées; Index)	1873		sufficient material for its completion.	
5	1-104 (Géraniacées-	late 1873 or	<b>Barham, H., Hortus americanus, etc.</b>		
	Vochysiacées)	early 1874	<i>cf.</i> C. D. SHERBORN, J. Soc. Bibl. Nat. Hist.		
	105-256 (Euphorbiacées)	1874	1 (1938) (142).		
	257-428 (Térébinthiacées-	late 1874 or		Though dated 1794, not received by the	
	Sapindacées)	early 1875		Gentlem. Magazine before Oct. 1795.	
	429-516 (Malpighiacées,	late 1874 or	<b>Barton, W. P. C., Compendium florae philadel-</b>		
	Méliacées; Index)	early 1875	<b>phicae, etc.</b>		
6	1-92 (Célastracées,		<i>cf.</i> O. KUNTZE, Rev. Gen. Pl. 32 (1898) 154.		
	Rhamnacées)	1875	Was issued about January 1818, at least earlier		
	93-216 (Pénéacées-	late 1875 or	than NUTTALL, The genera of N. Am. Plants		
	Ulmacées)	early 1876	(see there). BARTON cited NUTTALL from uncorrect-		
	217-304 (Castanécées-		ed galley proofs with the latter's consent.		
	Rhizophoracées)	1876	<b>Bateman, J., A monograph of Odontoglossum.</b>		
	305-523 (Myrtacées-				
	Balanophoracées;		<i>Part</i>	<i>Plates</i>	<i>Dates</i>
	Index)	1877	1	1-5	1864
7	1-256 (Mélastomacées-		2	6-10	1865
	Ombellifères)	1879	3	11-15	1866
	257-546 (Rubiacées-		4	16-20	1867
	Dipsacacées; Index)	1880	5	21-25	1873
8	1-316 (Composées)	1882	6	26-30,	1874
	317-515 (Campanulacées-			title-page,	
	Bégoniacées; Index)	1885		dedication,	
9	1-80 (Aristolochiacées-			list of plates,	
	Portulacacées)	1886		introduction,	
	81-224 (Caryophyllacées-			index	
	Frankéniacées)	1887			
	225-491 (Droseracées-				
	Scrofulariacées;				
	Index)	1888			
10	1-112 (Bignoniacées,				
	Gesnériacées)	1888			
	113-220 (Gentianacées,				
	Apocynacées)	1889			
	221-402 (Asclépiadacées-				
	Boraginacées)	1890			

Note. The above particulars taken from a copy in original wrappers examined by W. T. STEARN. Part 1 was reviewed in Gard. Chron. (1864) 702 (23 July 1864), part 2 in Gard. Chron. (1865) 607 (1 July 1865).

**Battandier, J. A.,** *Supplément aux Phanérogames, etc.*

*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 6 (1938) 146.

1 Vol., iii + 90 pp., dated 1910, but possibly issued early in 1911.

**Battandier, J. A.,** *Contributions à la flore atlantique.*

*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 6 (1938) 147.

1 Vol., 95 pp., published presumably a month or two after April 1919, the date of its preface.

**Battandier, J. A. & L. Trabut,** *Flore d'Alger, etc.*

*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 6 (1938) 145-146.

1 Vol., xvi + 211 pp., Jan. 1884.

**Battandier, J. A. & L. Trabut,** *Flore de l'Algérie, etc.*

*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 6 (1938) 145-146.

<i>Vol.</i>	<i>Part.</i>	<i>Pages</i>	<i>Dates</i>
1	1	i-xi, 1-184	Aug. 1888
	2	185-384	May 1889
	3	385-576	Nov. or Dec. 1889
	4	577-825, App. etc.	Dec. 1890
2		256 pp.	(prob. July) 1895
3		does not deal with phanerogams.	

**Battandier, J. A. & L. Trabut,** *Flore analytique . . . de l'Algérie.*

*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 6 (1938) 146.

One volume, 460 pp., dated 1902 on the title-page, 1904 on the wrapper, and apparently not available until early in 1905.

**Battandier, J. A., L. Trabut & later R. Maire,** *Atlas de la flore, etc.*

*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 6 (1938) 146.

<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1	1-16	1-11	1886
2	17-32	12-23	1896
3-4	33-59	24-47	1913
5	61-78	48-58	1920

**Beccari, O.,** *Malesia.*

*cf.* Malesia *l.c.* vol. 2, p. 340 and vol. 3, p. 420.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	1-96	Apr. 1877
	2	97-192	Sept. 1877
	3	193-256	Sept. 1878
	4	257-305	Dec. 1883
2	1	1-128	Dec. 1884
	2	129-212	Sept. 28, 1885
	3	213-284	June 12, 1886
	4	285-340	Dec. 1886

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
3	1	1-80	June 1886
	2	81-160	Sept. 1886
	3	161-168	Aug. 1887
	4	169-280	Sept. 1889
	5	281-432	Mar. 1890

**Beddome, R. H.,** *The flora sylvatica for Southern India. . .* accompanied by a botanical manual, *etc.*

The complete work forms two volumes; unfortunately neither has a dated title-page or particulars of issue. The main work consists of plates each illustrating a single species and accompanied by a page of descriptive text (with arabic pagination) but there is also an independently paged 'Forester's Manual of Botany for Southern India' (with Roman pagination) giving a survey of families and keys to genera and plates, illustrating the 'Analysis of Genera', each plate with floral details of two to eight genera. The following particulars have been taken from a copy at the Royal Botanic Gardens, Kew, which has the original wrappers preserved and their contents noted. No contemporary reviews have been noticed (W. T. STEARN *in litt.*).

<i>Parts</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1-3	1-36	1-36	1869
4-6	37-72, F.M. i-xvii	37-72, An.Gen. 1-2	1870
7-14	73-168, F.M. xix-lxxxii	73-168, An.Gen. 3-11	1871
15-24	169-288, F.M. lxxxiii-clxix	169-288, An.Gen. 12-22	1872
25-27	289-325 (326, 327?), F.M. clxxi-cxxxxvi	289-325 (326, 327?), An.Gen. 23-27 bis	1873
28	328-330, F.M. cxxxvi (of Add.) -cxxxxviii	328-330 (late) or 1874 (early)	

**Bélanger, Ch.,** *Voyage aux Indes-Orientales . . . 1825-29. Botanique I. Phanérogames.*

*cf.* C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 7 (1901) 390; *ibid.* 8 (1901) 494 (*non-bot.*); J. Bot. 39 (1901) 205.

Livr. 2 and 3 were issued in 1834 (Bibliogr. France), but apparently consisted of plates and wrappers.

In total 15 unnumbered plates of phanerogams were published, without text.

The 'Cryptogamic' by BÉLANGER, BORY DE ST. VINCENT & MONTAGNE (Botanique II) is usually quoted 1846.

**Bennett, J. J. & R. Brown,** *Plantae javanicae rariores* quas in insula Java, annis 1802-1818, legit et investigavit Thomas Horsfield.

The following information, derived from HORSFIELD's correspondence, Linnean Society library accession records and contemporary reviews in *Ann. Mag. Nat. Hist.*, Bent's Monthly Literary Advertiser, and Gard. Chron., has been supplied by W. T. STEARN (*in litt.*).

Part	Pages	Plates	Dates
1	1-104	1-24	4-7 July 1838
2	105-196	25-40	May 1840
3	197-238	41-45	Nov. 1844
4	239-258, i-xvi, map	46-50	8-31 May 1852

**Bentham, G., *Plantae Hartwegianae*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 154.

Pages	Dates	Pages	Dates
1-16	May 1839	201-208	Oct. 1845
17-24	June 1839	209-216	Nov. 1845
25-40	Feb. 1840	217-224	Mar. 1846
41-72	Mar. 1840	225-240	Apr. 1846
73-80	Feb. 1841	241-272	May 1846
81-88	Apr. 1841	273-284	June 1846
89-104	Jan. 1842	285-308	Dec. 1848
105-112	Feb. 1842	309-332	Aug. 1849
113-128	Dec. 1843	333-348	Feb. 1857
129-152	Dec. 1844	349-356	Mar. 1857
153-184	Aug. 1845	357-393	Apr. 1857
185-200	Sept. 1845		

Note. The dates taken from footnotes on the sheets; possibly in reality dates of printing.

**Bentham, G., *The botany of the voyage of H. M. S. Sulphur, etc.***

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 154; E. D. M. TUCKER, *J. Arn. Arb.* 11 (1930) 243-244.

Usually quoted 1844 (the date on the title-page) although the last page of text (p. 182) is dated 'January 1846'. KUNTZE examined a copy with original wrappers at Berlin and TUCKER a similar one in the library of the Arnold Arboretum. The dates in brackets below have been supplied by W. T. STEARN and are those on which the parts are received by the Linnean Society of London, to which they were presented on publication (see p. 3 of this Introduction).

Part	Pages	Plates	Dates
1	1-16	1-10	1844 (16 Jan. 1844)
2	17-48	11-20	1844 ( 2 Apr. 1844)
3	49-72	21-30	1844 (16 Aug. 1844)
4	73-96	31-40	1844 (25 Oct. 1844)
5	97-144	41-50	1845 (14 Apr. 1845)
6	145-194 (+ index)	51-60	1846 ( 8 May 1846)

**Bentham, G., *Flora australiensis*.**

*cf.* H. S. MARSHALL, *J. Soc. Bibl. Nat. Hist.* 1, part 3 (1937) 69-71.

Vol.	Dates
1	May 30, 1863
2	Oct. 5, 1864
3	Jan. 5, 1867
4	Dec. 16, 1868
5	not later than Oct. 1870
6	Sept. 23, 1873
7	on or before Mar. 30, 1878

**Bentham, G. & J. D. Hooker, *Genera plantarum*.  
*cf.* *Genera plantarum*.**

Vol.	Part	Pages	Dates
1	1	1-434, Addenda 435-439, Index 441-454, Consp. v-xii, Praemonenda (ending 'dabimus')	Aug. 1862
	2	433-725, Addenda 726, Index 727-734, Consp. Ord. Fasc. secundi (one page)	Oct. 1865
	3	721-1040, Consp. v-xv, Praemonenda (ending 'Octobri 1865')	Sept. or Oct. 1867
2	1	1-532, Addenda 535-537, Index 539-554, Consp. Ord. Dicot. Gamopet. Ovario infero	Apr. 1873
	2	533-1279, Consp. iii-viii	May 1876
	3	1-447, Addenda 448, Index 449-459, Consp. iii-vii	Feb. 1880
	2	447-1258, Consp. vii-xi	Apr. 1883

Note. The duplication of paging, whereby addenda and index concluding a part bear the same page-numbers as the first pages of descriptive text beginning the next part of the same volume, should be noted as new genera were published in these addenda; unfortunately they have sometimes been discarded by puzzled book-binders! The above information, supplied by W. T. STEARN, has been derived from parts as issued, BENTHAM's diary (at Kew), Linnean Society of London library accession records and contemporary notices in Gard. Chron., *J. Bot.* (London), and *Nat. Novitates*.

**Bentley, R. & H. Trimen, *Medicinal plants, etc.***

*cf.* B. L. BURTT, *Not. R. Bot. Gard. Edinb.* 21 (1953) 157-162.



Part	Dates	Part	Dates
1	Oct. 1875	22	July 1877
2	presumably Nov. 1875	23	Aug. 1877
3	Dec. 1875	24	Sept. 1877
4	Jan. 1876	25	Oct. 1877
5	Feb. 1876	26	Nov. 1877
6	Mar. 1876	27	Nov. 1877
7	Apr. 1876	28	Jan. 1878
8	May 1876	29	Feb. 1878
9	June 1876	30	Mar. 1878
10	July 1876	31	Apr. 1878
11	Aug. 1876	32	(25 May 1878)
12	Sept. 1876	33	1878
13	Oct. 1876	34	1878
14	Nov. 1876	35	1878
15	Dec. 1876	36	(17 Dec. 1878)
16	Jan. 1877	37	( 7 Mar. 1879)
17	Feb. 1877	38	1879
18	Mar. 1877	39	(24 June 1879)
19	Apr. 1877	40	5 Sept. 1879
20	May 1877	41	(15 Dec. 1879)
21	June 1877	42	(19 Feb. 1880)
			+Preface & title

Note. Dates have been ascertained from the wrappers; those in brackets are dates of receipt at the Edinburgh Museum.

The plates were not issued in numerical order; for full particulars on the plate numbers published in different parts, see Not. R. Bot. Gard. Edinb. l.c.

**Berg, O. K.,** *Revisio Myrtacearum Americae, etc.* (in *Linnaea* vol. 27, 29, and 30).

cf. I. URBAN, Bot. Jahrb. 19 (1894) 562.

In vol.	Part	Pages	Dates
27	1	1-128	Nov. 1855
	2 & 3	129-384	Jan. 1856
	4	385-512	Feb. 1856
29	2	207-256	June 1858
	3	257-264	Sept. 1858
30	6	647-713	Mar. 1861

**Bergius, P. J.,** *Descriptiones plantarum ex Capite Bonae Spei, etc.*

cf. T. A. SPRAGUE, Kew Bull. (1929) 88-89.

It is assumed that this work appeared in Sept. 1767 and before LINNÉ'S *Mantissa* (see there).

**Billardiére, J. J. H. de la,** *Relation du voyage à la recherche de la Pérouse, etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxiii.

Was published in the 8th year of the French Republic, usually converted into 1799. KUNTZE puts it at 1800 as the Republican year starts only at Sept. 22 of our Gregorian year.

**Billardiére, J. J. H. de la,** *Novae Hollandiae plantarum specimen.*

Vol. 1 (pp. 1-112, pls 1-142) is dated '1804' but judging from contemporary references it is probable that only the first part (pls 1-10) appeared in 1804, most (pls 11-120) in 1805, the rest (pls 121-142) in 1806.

Vol. 2 (pp. 1-130, pls 143-265) is dated '1806' and probably most of it (pls 143-240) appeared in 1806, but parts (pls 241-265) in 1807.

The whole work was issued in 26 parts; their exact contents are uncertain, but usually each contained 10 plates. It merits further investigation (W. T. STEARN *in litt.*).

According to PRITZEL, Thes. Lit. Bot. 1872, the work was issued from 1803-07 in 26½ parts (M. J. VAN STEENIS-KR.).

**Blanco, M.,** *Flora de Filipinas*. 3rd edition.

cf. E. D. MERRILL, Philip. J. Sc. C. Bot. 12 (1917) 113-116.

Vol.	Part	Pages	Dates
1	1-24		1877
2	1-19	1-304	1878
	20-28	305-419	1879
		(+ index)	
3	7 pts		1879
4	1A-12A		1880

Note. For part 13A-23A and 'Entrega ultima', see *sub* FERNANDEZ-VILLAR & NAVES.

**Blume, C. L.,** *Bijdragen tot de Flora van Nederlandsch Indië.*

cf. H. C. D. DE WIT, Fl. Mal. Bull. no 4 (1948) 96-97 (see also *ibid.* p. 193).

Part	Pages	Dates
1	1-42	Mar. 15-May 31 (prob. last week of May) 1825
2-9	48-484	June 1-Dec. 7 (prob. 1st week of Dec.) 1825
10-12	487-636	Dec. 7, 1825-Mar. 15, 1826 (prob. Jan.-Feb. 1826)
13	638-730	Dec. 7, 1825-Mar. 15, 1826 (prob. Feb. 1826)
14-15	731-942	July-Dec. 1826
16-17	944-1169	Oct. 1826-Mar. 1827

**Blume, C. L.,** *Tabellen en platen voor de Javaansche Orchideën.*

cf. H. C. D. DE WIT, Fl. Mal. Bull. no 4 (1948) 96-97.

The 6th instalment of the 'Bijdragen' was completed by this simultaneously issued atlas. It probably appeared in the first week of Dec. 1825 (see previous entry).

**Blume, C. L.,** *Enumeratio plantarum Javae, etc.*, ed. 1830.

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxiv.

Evidently an unrevised new edition of 1827-28; for nomenclatural questions the date of the 1st edition is conclusive.

**Blume, C. L.,** *Flora Javae, etc.*

cf. B. H. DANSER, *Blumea* 3 (1939) 203-211; C. G. J. VAN STEENIS, Fl. Mal. Bull. no 2 (1947) 49; *Blumea* 6 (1948) 263; H. C. D. DE WIT, Fl. Mal. Bull. no 5 (1949) 138-141.

<i>Families</i>	<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>	<i>Vol.</i>	<i>Part</i>	<i>Probable date of issue</i>	<i>Pages</i>	<i>Plates</i>
Rhizanthæae	1-2	1-26	1-6	5-8-1828 (p.25-26 on 3-1-1829)	2 (1836)	16-21	Dec. 1838 (pl. 71-85 issued with pt 13-15)	1-176	86-137
Filices	3-4	1-36	1-12	17- 1-1829					
	5-6	37-56	13-22	17- 3-1829					
Dipterocarpeae	7-8	1-24	1-6	2- 5-1829	3 (1847)	22-24	Oct. 1839	1-224	138-173
Chloranthæae		1-14	1-2			25-30	Dec. 1842- April 1843		
Filices	9-10	57-84	23-36	12- 5-1829 (not 26)		31-36	Before May 1843 (DE WIT) or Jan. 1849 (LORENTZ)		
Cupuliferae	11-12	1-24	1-12	3- 7-1829					
	13-14	25-46	13-24	24- 7-1829					
Filices	15-16	85-112	37-47	31- 8-1829	4 (1848)	37-40	Oct. 1849	1-75	174-200
Myricæae,	17-18	1-8	1	17-10-1829					
Balsamifluae,		1-12	1-2						
Juglandæae		1-16	1-5						
Magnoliaceae	19-20	1-40	1-12	25-11-1829					
Anonaceae	21-22	1-36	1-14	25- 1-1830					
	23-24	37-56	15-27	18- 3-1830					
Filices	25-27	113-152	48-65	14- 4-1830					
Anonaceae	28-29	57-80	28-39	30- 4-1830					
	30-31	81-100	40-50	29- 5-1830					
Anonaceae,	32-33	100-108	51-53	25- 6-1830					
Schizandreae		1-18	1-5						
Loranthæae	34-35	1-24	1-16	16- 8-1830					
Filices	36-39	153-184	66-88	31- 8-1847 (not 68)					
	40	185-196	89-94	31- 3-1851					
Loranthæae	41-42	25-40	17-28	31- 3-1851					
Orchideae	Ser. II vol. 1			1858					
'Supplément' or 'Planches Inédites' between 1863 and 1883.									

Note. It was stated in literature that vol. 1 comprised 15 fascicles; as to the fascicles of the other volumes no pertinent data were found. The sets of fascicles are in accordance with the way in which they were received at Teyler's Library. About fasc. 31-36 there is a distinct discrepancy of the dates; DE WIT's date for vol. 3, pt 31-36 is not confirmed by the title-page date of BLUME: 1847.

Blume, C. L., *Museum botanicum*, etc.

cf. J. G. B. BEUMÉE, *Fl. Mal. Bull. no 3* (1948) 69-70.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	5-16	Jan. 1849
	2	17-32	Mar. 1849
	3	33-48	Apr. 1849
	4	49-64	Apr. 15, 1849
	5	65-80	May 1, 1849
	6	81-96	June 1, 1849
	7	97-112	Aug. 1849
	8	113-128	Oct. 1849
	9	129-144	Dec. 1849
	10	145-160	Jan. 1850
	11	161-176	Feb. 1850
	12	177-192	Mar. 1850
	13	193-208	Apr. 1850
	14	209-224	May 1850
	15	225-240	June 1850
	16	241-256	July 1850
	17	257-272	Sept. 1850
	18	273-288	Oct. 1850
	19	289-304	Nov. 1850
	20	305-320	Dec. 1850
	21	321-336	... 1851
	22	337-352	... 1851
	23	353-368	... 1851
2	24	369-396	... 1851
	1-8	1-128	Feb. 1856
	9-12	129-192	May 1856
	13	193-208	... 1856
	14	209-224	... 1856
	15	225-240	... 1856
	16	241-256	... 1856

Blume, C. L., *Mélanges botaniques I-II*.

cf. Anonymous review in *Flora* 41 (1858) 254-256; and request of MIQUEL in *Bot. Zeit.* 14 (1856) 176.

<i>Vol.</i>	<i>Part</i>	<i>Probable date of issue</i>	<i>Pages</i>	<i>Plates</i>
1 (1835)	1-3	First half of 1836	1-124	1-52
	4-6	July or Aug. 1836		
	7-9	Nov. 1836		
	10-12	June or July 1837	125-164	53-70
	13-15	Dec. 1837 (the plates belong to vol. 21)	165-204	71-85

Two loose-leaved parts appeared, the first dated Aug. 1, 1855, the second Sept. 1, 1855. On the title-page it was mentioned that it could not be bought at the bookseller's.

In 1857 C. MUELLER in Walp. Ann. 4, p. 642-644 published descriptions referring to BLUME's Mél. Bot., which were later copied by MIQUEL (Fl. Ind. Bat. I, 1, 1858, p. 1084-1085). MUELLER's data are more complete than those of the anonymous account of the contents of the Mélénges in Flora l.c., but on the other hand he does refer to species only, *not mentioning any page numbers!* It still seems doubtful whether MUELLER actually saw a copy.

Evidently no copy of this work is present in Dutch libraries. As it is supposed that at least some people in Germany saw one, a request was made to German libraries, but no copy was located.

It must have been most annoying to MIQUEL, when starting his Fl. Ind. Bat., to have BLUME publishing new species *etc.* of the same region without being able to get hold of a copy of the 'Mélénges', which were privately published. And he certainly never got hold of one, otherwise he would have referred to it somewhere else. If BLUME had distributed copies privately, there would have been a good chance that some day one would have come into MIQUEL's hands. BLUME has apparently, for reasons unknown to me, distributed no copies at all. No trace of any copy of the 'Mélénges' has ever turned up, neither at Leyden nor elsewhere. BLUME might have suppressed it after an unpaid proof (*vide* 'die losen Blätter' mentioned in Flora l.c.) was drawn.

Another possibility is that the 'Mélénges' formed the text of 2 instalments intended for the 'Museum botanicum', as it is a remarkable coincidence that the treatment of the Malaysian *Chrysobalanee* in the Mus. Bot. 2 (Feb. 1856) 90-99 is confined to *Parinarium* and does not contain any reference to the 'Mélénges' which dealt mostly with *Chrysobalanee*, *Broussonetia* and *Cunoniaceae*, and were dated Aug.-Sept. 1855, that is half a year earlier! I did not find any other reference of BLUME himself to his 'Mélénges'.

From the inferences mentioned it is clear, that the issue was suppressed before having been distributed. The new names of the 'Mélénges' date therefore, from their publication by MUELLER in WALPERS, Ann. 4 (1857) and the abstract in Flora 41 (1858).

C. G. G. J. VAN STEENIS

Boeckeler, O., Die Cyperaceen des Königlichen Herbariums zu Berlin.

cf. H. K. SVENSON, Rhodora 41 (1939) 313.  
Appeared in scattered numbers of the journal 'Linnaea'.

Vol.	Pages	Dates
35	397-512	wrapper lacking
(1867-1868)	513-612	Nov. 1868

Vol.	Pages	Dates
36	271-384	Jan. 1870
(1869-1870)	385-512	Apr. 1870
	691-768	Dec. 1870
37	1-544	Feb. 1871
(1871-1873)	545-647	Sept. 1873
38	223-256	wrapper lacking
(1874)	257-384	May 1874
	385-512	July 1874
	513-544	wrapper lacking
39	1-152	Feb. 1875
(1875)		
40	327-384	Aug. 1876
(1876)	385-452	Dec. 1876
41	145-192	Feb. 1877
(1877)	193-288	Apr. 1877
	289-356	Aug. 1877

Boissier, E., Diagnoses plantarum orientalium novarum.

cf. G. A. PRITZEL, Thes. Lit. Bot. (1872) 33;  
O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxiv.

Vol.	Part	Pages	Dates
1	1	76 pp.	1842
	2	115 pp.	1843
	3	60 pp.	1843
	4	86 pp.	1844
	5	91 pp.	1844
	6	136 pp.	1845
	7	130 pp.	1846
2	8	128 pp.	1849
	9	131 pp.	1849
	10	122 pp.	1849
	11	136 pp.	1849
	12	120 pp.	1853
	13	114 pp.	1853
		(+ index)	
3	1	120 pp.	1853
	2	125 pp.	1856
	3	177 pp.	1856
	4	146 pp.	1859
	5	118 pp.	1856
	6	148 pp.	1859
		(+ index)	

Boissier, E., Flora orientalis, etc.

cf. P. H. DAVIS, Kew Bull. (1949) 426.  
Volumes 4 and 5 are found in libraries bearing the dates 1879 and 1884 respectively. They were published as follows:

Vol.	Part	Pages	Dates
4	1	1-280	1875
	2	281-1276	1879
5	1	1-428	July 1882
	2	429-868	Apr. 1884

Bonnier, G. E. M. & R. Douin, Flore complète, illustrée... de France, Suisse et Belgique.

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 2 (1950) 212-215.

Vol.	Part	Dates
1	1-10	July 1911-July 1912
2	11-20	? end of 1912-July 1913
3	21-30	1913-July 1914
4	31-40	up to Jan. 1921
5	41-50	up to Jan. 1922
6	51-60	up to Feb. 1923
7	61-70	up to Sept. 1924
8	71-80	up to Mar. 1926
9	81-90	up to July 1927
10	91-100	1928-Apr. 1929
11	101-110	1929-Dec. 1931
12	111-120	1932-1934
13	Table générale ... Corrections et Additions	Apr. 1935

Note. More extensive particulars can be found in STEARN's paper.

**Bonpland, A. J. A. G.,** *Description des plantes rares cultivées à Malmaison et à Navarre.*

cf. W. T. STEARN, *J. Arn. Arb.* 23 (1942) 110-111.

Part	Pages	Plates	Dates
1	1-16	1-6	Nov. or Dec. 1812
2	17-32	7-12	Aug. or Sept. 1813
3	33-48	13-18	Jan. 1814
4	49-60	19-24	Nov. or Dec. 1814
5	61-76	25-30	Apr. or May 1815
6	77-88	31-36	June or July 1815
7	89-100	37-42	June or July 1816
8	101-120	43-48	Aug. or Sept. 1816
9	121-144	49-54	Oct. or Nov. 1816
10	145-152	55-60	Nov. or Dec. 1816
11	153-157	61-64	Mar. or Apr. 1817

**Botanische Jahrbücher.**

cf. J. BRITTEN, *J. Bot.* 39 (1901) 237.

In a supplement to vol. 26, Beibl. 61 (1899) 5-8, a list of the dates of each part of the preceding twenty-five volumes is given. In later volumes the date of each of the parts composing the volume is given on the back of the title-page.

**Botanisk Tidsskrift** vol. 17.

See *sub* KIAERSKOU, *Myrtaceae*.

**Breda, J. G. S. van,** *Genera et species Orchidacearum, etc.*

cf. H. C. D. DE WIT, *Fl. Mal. Bull.* 6 (1950) 165-167.

Part	Dates	Part	Dates
1	Nov. 18, 1828	3	Aug. 15, 1829
2	prob. 1st half of 1829		

**Brongniart, A. Th.,** *Botanique (Phanérogamie) du Voyage... sur la Coquille.*

cf. C. D. SHERBORN & B. B. WOODWARD, *Ann. Mag. Nat. Hist.* VII, 7 (1901) 391-392; *J. Bot.* 39 (1901) 206; *J. MAIDEN, J. & Proc. R. Soc. N.S.W.* 44 (1910) 140-142.

Part	Pages	Dates
7	1-40	July 1829
8	41-88	Mar. 1831
9	89-104	June 1831
10	105-136	Mar. 1832
11-14	137-200	July 1834
? 15	201-232	?

Note. Evidently there are copies containing 200 pp. and others with 232 pp.; in both cases the work ends abruptly.

**Brown, R.,** *On the Asclepiadeae, a natural order of plants separated from the Apocineae of Jussieu* (in *Mem. Werner. Nat. Hist. Soc.* vol. 1, p. 12-78).

cf. D. P. ROGERS, *Taxon* 2 (1953) 181-182; A. A. BULLOCK in *Kew Bull.* (1953) 64-65.

As some new genera are described, the question arose whether the date of publication of these is 1809 or 1811. In the absence of proof that this volume of the *Memoirs* (dated 1811, but bearing the phrase for 1808, -9, -10) was distributed in parts, 1811 is accepted by ROGERS as the correct date. BULLOCK, however, accepts 1809 as reprints exist of BROWN's paper and such reprints of other papers in the Wernerian Natural History Society's *Memoirs* were issued before publication of the whole volume.

**Brown, R.,** *Prodromus florae Novae Hollandiae et insulae Van-Diemen.*

cf. J. BRITTEN, *J. Bot.* 45 (1907) 247.

Published early in 1810 (March to May).

**Browne, Patrick,** *Civil and Natural History of Jamaica.*

cf. A. B. RENDLE, *J. Bot.* 50 (1912) 129.

The 1st edition appeared in 1756. I do not know why RENDLE states that 'the Rules of nomenclature do not allow his new names to take precedence of or compete with subsequently published names.' This is possibly due to the fact that BROWNE did not employ the binomial system. As a matter of fact he provided the species with numbers, and not with specific epithets. However, he recognized genera and species, and many times he cites LINNAEUS's *Sp. Pl.* He did not give generic descriptions, but as far as his genera are monospecific the generic names are perfectly legitimate under Art. 50 of the Rules. The Rules also recognize their legitimacy, otherwise none ought to have been rejected and none ought to have been conserved. Cf. Code (1952) p. 87 *no* 358 and p. 136 *no* 8399.—VAN STEENIS.

**Bunge, A. von,** *Enumeratio plantarum quas in China Boreali collegit, etc.*

cf. W. T. STEARN, *J. Bot.* 79 (1941) 63-64.

This paper was read to the Académie Impériale des Sciences at St Petersburg on 7 March 1832, but the title-page of the *Mém. Savant. Étrang.* Acad. Sc. St-Petersbourg vol. 2 (occupying p. 75-148) is dated '1835'. It certainly was issued before the end of 1833, as at that time BUNGE's

paper had reached Geneva. STEARN accepts March 1833 as its date of issue.

**Cambessèdes, J., *Plantae rariores, etc.*** (in vol. 4 of V. JACQUEMONT, *Voyage dans l'Inde*).

*cf.* C. D. SHERBORN & B. B. WOODWARD, *Ann. Mag. Nat. Hist.* VII, 8 (1901) 334.

The botanical part of vol. 4 was published in 1844. It is accompanied by *Atlas II* (1844).

**Candolle, A. P. de, *Plantarum historia succulentarum*.**

*cf.* W. T. STEARN, *Cactus & Succ. J.*, G. B. 7 (1938) 37, footnote.

Part	Plates	Dates
1	1-6	Dec. 1798 or Jan. 1799
2-4	7-24	1799
5-9	25-54	1800
10	55-60	Dec. 1800 or Jan. 1801
11-14	61-84	1801
15	85-90	1801 or 1802
16-18	91-108	1802
19-24	109-138	1803
25-28	139-159	1804 or 1805
29-31	(160-182, unnumbered)	1829

**Candolle, A. P. de, *Regni vegetabilis systema naturale*.**

*cf.* W. T. STEARN, *J. Bot.* 79 (1941) 25-27.

Vol.	Dates
1	early Nov. 1817
2	late May 1821

**Candolle, A. P. & A. de, *Prodromus systematis naturalis regni vegetabilis, etc.***

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxv; *ibid.* 32 (1898) 154-155; W. T. STEARN, *Candollea* 8 (1939-41) 1-4.

Vol.	Part	Pages	Approximate date of issue
1			mid Jan. 1824
2			mid Nov. 1825
3			mid Mar. 1828
4			late Sept. 1830
5			early Oct. 1836
6			early Jan. 1838
7 <sup>1</sup>			late Apr. 1838
7 <sup>2</sup>			late Dec. 1839
8			mid Mar. 1844
9			early Jan. 1845
10			early Apr. 1846
11			late Nov. 1847
12			early Nov. 1848
13 <sup>1</sup>			mid May 1852
13 <sup>2</sup>			early May 1849
14	1	1-492	mid Oct. 1856
	2	493-706	late Nov. 1857
15 <sup>1</sup>			early May 1864
15 <sup>2</sup>	1	1-188	late Jan. 1862
	2	189-1286	late Aug. 1866
16 <sup>1</sup>			mid Nov. 1869

Vol.	Part	Pages	Approximate date of issue
16 <sup>2</sup>	1	1-160	late Dec. 1864
	2	161-691	mid July 1868
17			mid Oct. 1873
17, p. 323-493	contains a general index to the genera and families. The complete index by H. W. BUEK, was published in parts, viz:		
	to vols 1-4		early in 1843
	5-7 <sup>1</sup>		Oct. 1840
	7 <sup>2</sup> -13		late in 1858
			or early in 1859
	14-17		1874 (by Aug.)

Note. Not all sets of the *Prodromus* possess BUEK's keys, in which a number of new names were proposed.

**Carrière, E. A., *Traité général des Conifères, etc.***

*cf.* W. T. STEARN, *Ann. R. Bot. Gard. Calc.* 150th Annivers. vol. (1942) 115.

Issued June 1855.

**Cavanilles, A. J., *Monadelphiae classis dissertationes decem*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxvi.

Part	Pages	Part
1	1-48	1785
2	Up to p. 106 + 4 pp. App.	1786
3-4	Up to p. 266	1787
5-6	Up to p. 354	1788
7-8	Up to p. 414	1789
9-10	Up to p. 464	1790

**Chapman, A. W., *Flora of the Southern United States, etc.***

*cf.* E. D. MERRILL, *J. South. Appal. Bot. Club* 13 (1948) 61-70.

1st ed., i-xxxvii + 1-621 pp., 1860.

2nd ed., i-xxxviii + 1-698 pp., 1883.—The text up to p. 602 is the same as that of the 1st ed., but a supplement, p. 603-673, with an index to that supplement, p. 695-698, was added.

2nd ed., i-xxxviii + 1-724 pp., 1892. Reprint of the 2nd ed. to which was added a second supplement, p. 655-703. The title-page of this issue is undated, and the copyright date is 1883; at the end of the preface, p. vi, is a statement explaining the reasons for publishing the 2nd supplement, dated Aug. 10, 1892. Thus 1892 may safely be accepted as the year of publication of this second issue of the 2nd ed.

3rd ed., i-xxxix, 1-655 pp., 1897. Actually a new work, for the type was entirely reset.

**Colla, L., *Herbarium pedemontanum, etc.***

*cf.* R. PICHI-SERMOLLI, *Webbia* 8 (1911) 130-140.

Vol.	Plates	Title page date	Probable date of issue
1		1830	Dec. 1833
2		1834	July 1834
3		1834	Jan.-Feb. 1835
4	fasc. 1	1835	Aug. 1835 (2nd half)
5	fasc. 2	1836	Apr. 1836
6		1836	Nov.-Dec. 1836
7		1837	summer or autumn 1837
8	fasc. 3	1837	summer or autumn 1837

Note. PICHI-SERMOLLI listed the species described by COLLA on *l.c.* p. 134-139, 410-411.

Colla, L., *Plantae rariores in regionibus chilensibus*, etc. (in Mem. R. Accad. Sc. Torino vol. 37-39).

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxvi; R. PICHI-SERMOLLI, Webbia 8 (1951) 123-130, 134-140; *ibid.* 8 (1952) 407-411.

In vol.	Part	Pages	Plates	Date of volume
37	1 } 2 } 3 }	41-85	1-20	last months of 1834 <sup>1</sup>
38	4 } 5 } 6 }	1-42	21-34	Nov.-Dec. 1835
	5 }	117-141	35-47	
39	7	1-55	48-75	Apr. 1837 <sup>2</sup>

The same parts with corresponding plates issued as reprints:

Part	Pages	Date of reprint
1 } 2 } 3 }	without indication	1-47 before autumn 1833 <sup>1</sup>
4 } 5 }	with indication fasc. 2	1-42 2nd half of 1834 (before corresponding vol.)
6	with indication fasc. 6	1-27 distributed in 1837 (later than corresponding volume)
7	indicated fasc. ult.	1-55 early months of 1837 <sup>2</sup>

Note. For the respective species see lists by PICHI-SERMOLLI in *l.c.* p. 134-139, 410-411. The dates given by KUNTZE (not mentioned here) are the dates of reading at seven different meetings of the 'Reale Accademia delle Scienze di Torino'!

Cosson, E. St. Ch., *Compendium florum atlanticae* . . . , etc.

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 5 (1938) 148-149.

(1) G. SAVI already published the diagnoses in Nuov. Giorn. Litt. 24 (autumn 1832) 143-148. Species listed by PICHI-SERMOLLI in *l.c.* p. 410-411.

(2) Species earlier described in COLLA, Herb. Pedem. vol. 5 and 6.

Vol.	Pages	Dates
1	265 pp.	Sept. 1881
2	cvi + 367 pp.	Nov. 1887

Cosson, E. St. Ch. & G. Baratte, *Illustrationes florum atlanticae*.

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 5 (1938) 149-150; E. D. MERRILL, J. Arn. Arb. 22 (1941) 455-456.

Vol.	Part	Pages	Plates	Dates
1	1	1-36	1-25	Sept. 1882 (Oct. 10)
	2	37-72	26-50	Aug. 1884
	3	73-120	51-73	Dec. 1888 (Jan.-Feb. 1889)
	4	121-159	74-98	Oct. 1890 (Jan. 10, 1891)
2	5	7-42	99-123	Feb. 1892 (April)
	6	43-83	124-148	Nov. 1893 (Nov.-Dec.)
	7	1-6, 83-125	149-175	May 1897 (July-Aug.)

Note. The first date mentioned is taken from the original fascicle cover by MERRILL, the dates in brackets have been derived by STEARN from a critical search of records and reviews.

Cosson, E. St. Ch. & M. Ch. Durieu de Maisonneuve, *Flora d'Algérie. II. Phanérogamie. Groupe des Glumacées* (in: Exploration scientifique de l'Algérie).

cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 8 (1901) 162; W. T. STEARN, J. Bot. 79 (1941) 116-117.

Part	Pages	Dates
1	1-120	prob. May or June 1855
2	121-241	prob. Nov. or Dec. 1855
3	241-330	Jan. 1868 (or late 1867)
	+ i-cx	

Atlas containing 90 coloured plates was published between 1846-1849 with annotated list (publ. 1868). According to A. REHDER (Bradley Bibliogr. 1, 1911, 484) some copies are dated 1850. No descriptive text issued, but plates with *floral diagnoses*. Latin diagnoses of 39 species were published in advance in DUCHARTRE, Revue Botanique 1 (1846) 359-368, and *ibid.* 2 (1847) 424-439.

Coyte, W. B., *Hortus botanicus Gippovicensis*, etc.

cf. C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1 (1938) 142.

Received by the Gentlem. Magazine in June 1796 (see Review on p. 500).

Curtis, W., *Flora Londinensis*, etc.

cf. B. D. JACKSON, J. Bot. 19 (1881) 309-310; *ibid.* 54 (1916) 153-164 (index); W. A. CLARKE, J. Bot. 33 (1895) 112; *ibid.* 37 (1899) 390-395 (list

of the plates); G. C. DRUCE, Bot. Soc. & Exch. Cl. Br. Isles Rep. for 1917, 4 (1917) 432; *ibid.* 5 (1919) 412-414; F. N. WILLIAMS, J. Bot. 57 (1919) 100; W. T. STEARN, in FEDDE, Rep. 45 (1938) 216-217.

Published in 6 fascicles, each containing 72 plates, issued in numbers of 6 plates.

Part	No	Dates
1	1	May 1775
	2-12	before July 1777
2	13-24	1777-1778
3	25-36	(no 32 after Oct. 1780)
4	37-48	(no 39 end of 1781)
5	49-60	?1783-Nov. 1788
6	61-64	dated Jan. 1, 1791, prob. published before that date.
	65	March 1791
	66	Dec. 1, 1791
	67	prob. 1792 or 1793 (last no quoted by SIBTHORP in Fl. Oxon. 1794)
	68	} in or before 1794
	69	
	70	
	71	prob. 1795
	72	1798

Note. CURTIS's name of *Poa procumbens* has priority over *Poa rupestris* WITHERING (see DRUCE in *l.c.* 4, 1917, 432-434).

For nos 65-67 DRUCE's dates which are earlier than those of WILLIAMS, are accepted here.

**Decaisne, J.,** *Plantes vasculaires* (in DUMONT d'URVILLE, Voyage au Pôle Sud... sur les corvettes l'Astrolabe et la Zélée, etc. Botanique. Vol. 2).

cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 7 (1901) 390-391.

Issued in 1853. See for the Atlas *sub* HOMBRON & JACQUINOT.

**Decaisne, J.,** *Botanique* (in DU PETIT-THOUARS, Voyage de La Vénus, vol. 5, part 2).

cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 8 (1901) 492.

All the plates of Botany were out by 1855, and possibly 1846; the text was issued Sept. 3, 1864.

**De Candolle,** cf. CANDOLLE, DE.

**Delile, A. R.,** *Énumération des plantes recueillies par MM. Ferret et Galinier* (in: Voyage en Abyssinie... par MM. Ferret et Galinier, vol. 3).

cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 8 (1901) 161.

The 3rd volume, comprising plants, mammals, and part of the birds (p. 85 up to 224), are considered to date from 1848.

The plants are described on p. 85-163. The work is evidently accompanied by an Atlas, dated Paris 1847-48.

**Desfontaines, R. L.,** *Flora atlantica, etc.*

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 5 (1938) 147-148.

Vol.	Part	Pages and plates	Dates
1	1	p. 1-'Triandria Digynia' (part), pl. 1-30	Apr. 1798
	2	'Triandra Digynia' (part)-'Pentandria Digynia' (part), pl. 31-60	June 1798
	3	'Pentandria Digynia' (part)-'Hexandria Monogynia' (part), pl. 61-90	July 1798
	4	'Hexandria Monogynia' (part)-p. 444, pl. 91-120	Sept. 1798
2	5	p. 1-80, pl. 121-150	Oct. 1798
	6	p. 81-'Diadelphia Decandria' (part), pl. 151-180	Nov. 1798
	7	'Diadelphia Decandria' (part)-'Polyadelphia Polyandria' (part), pl. 181-210	Feb. 1799
	8	'Polyadelphia Polyandria' (part)-p. ?, pl. 211-240	June 1799
	9	p. ?-458, pl. 241-261	July 1799

The original title-pages are inaccurate or misleading; copies agreeing as to text and plates often differ in the dating of their title-pages.

**Desvaux, A. N.,** *Journal de botanique, appliqué à l'agriculture, à la pharmacie, à la médecine, et aux arts.*

cf. E. D. MERRILL, J. Arn. Arb. 28 (1947) 247-250.

Vol.	Part and Dates
1	1813 (possibly Jan.-June).
2	1813 (possibly July-Dec.).
3, 4 parts, part 5	1814. not before Feb. 1816! Vol. 3 is incomplete. All but one set Dr MERRILL saw, ended abruptly with p. 192; the set in the library of N.Y. Bot. Garden contains p. 193-240, indicated as number 5, May 1814. A footnote on p. 197 indicates, however, that it was not published before Feb. 1816. Dr MERRILL never saw a reference to an existing copy of part 6 of this volume.
4	1814
5	Was planned for 1815, but was never issued.

**Dictionnaire des sciences naturelles.**

cf. A. H. G. CASSINI, Opusculs Phytologiques 3 (1834) 145-162; C. D. SHERBORN, Index Animalium 1801-50, 1 (1922) xliv; W. T. STEARN in *litt.* (Nov. 1953).



<i>Vol.</i>	<i>Dates</i>
1 Suppl.	Oct. 1816 (Oct. 1816)
2 "	Oct. 1816 (Oct. 1816)
3 "	Dec. 1816 (Jan. 1817)
4 "	Dec. 1816 (Jan. 1817)
5 "	Mar. 1817 (Mar. 1817)
6 "	May 1817 (May 1817)
7 "	May 1817 (May 1817)
8 "	Aug. 1817 (Aug. 1817)
9 "	Dec. 1817 (Dec. 1817)
10 "	May 1818 (May 1818)
11 "	Dec. 1818 (Jan. 1819)
12 "	Dec. 1818 ( ? )
13 "	July 1819 (July 1819)
14 "	Aug. 1819 (Aug. 1819)
15 "	Nov. 1819 (Nov. 1819)
16 "	Apr. 1820 (Apr. 1820)
17 "	July 1820 (July 1820)
18 "	Apr. 1821 (Apr. 1821)
19 "	Jan. 1821 (Jan. 1821)
20 "	June 1821 (June 1821)
21 "	Sept. 1821 (Sept. 1821)
22 "	Dec. 1821 (Dec. 1821)
23 "	Nov. 1822 (Dec. 1822)
24 "	Aug. 1822 (Aug. 1822)
25 "	Nov. 1822 (Nov. 1822)
26 "	May 1823 (June 1823)
27 "	June 1823 (July 1823)
28 "	Sept. 1823 (Sept. 1823)
29 "	Dec. 1823 (Dec. 1823)
30 "	May 1824 (May 1824)
31 "	Aug. 1824 (Aug. 1824)
32 "	Nov. 1824 (Nov. 1824)
33 "	Dec. 1824 (Jan. 1825)
34 "	Apr. 1825 (June 1825)
35 "	Oct. 1825 (Oct. 1825)
36 "	Oct. 1825 (Oct. 1825)
37 "	Dec. 1825 (May 1826)
38 "	Dec. 1825 (Apr. 1826)
39 "	Apr. 1826 (Apr. 1826)
40 "	June 1826 (June 1826)
41 "	June 1826 (Sept. 1826)
42 "	Aug. 1826 (Sept. 1826)
43 "	Sept. 1826 (Sept. 1826)
44 "	Dec. 1826 (Jan. 1827)
45 "	Feb. 1827 (Feb. 1827)
46 "	Apr. 1827 (May 1827)
47 "	May 1827 (June 1827)
48 "	June 1827 (July 1827)
49 "	Sept. 1827 (Oct. 1827)
50 "	Nov. 1827 (Nov. 1827)
51 "	Dec. 1827 (June 1828)
52 "	Mar. 1828 (Apr. 1828)
53 "	May 1828 (June 1828)
54 "	Apr. 1829 (Apr. 1829)
55 "	Aug. 1828 (Aug. 1828)
56 "	Sept. 1828 (Oct. 1828)
57 "	Dec. 1828 (Jan. 1829)
58 "	Feb. 1829 (Mar. 1829)
59 "	June 1829 (no record)
60 "	June 1830 (July 1830)

publication was then suspended till 1816, when these volumes were brought up to date by means of supplements, and the work was completed' [Cat. Books Brit. Mus. (Nat. Hist.) 1, p. 458]. The dates given first above are those recorded by the Parisian botanist A. H. G. CASSINI, who contributed numerous articles on Compositae; they are followed (in brackets) by the dates as ascertained by C. D. SHERBORN from other evidence (reviews, *etc.*), CASSINI's contemporary account being unknown to SHERBORN. Their close agreement, with rarely more than a month's divergence, shows CASSINI's record to be trustworthy, since reviews and announcements are sometimes delayed (W. T. STEARN *in litt.*).

**Domin, K.,** Beiträge zur Flora und Pflanzengeographie Australiens (Bibl. Bot. Heft 89).

*cf.* C. G. G. J. VAN STEENIS, Fl. Mal. Bull. 5 (1949) 137.

<i>Part</i>	<i>Pages</i>	<i>Dates</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1-90 (555-644)	1921	4	287-382 (841-936)	1927
2	91-186 (645-740)	1925	5	383-478 (937-1032)	1928
3	187-286 (741-840)	1926	6	479-763 (1033-1417)	1929

**Don, D.,** Prodrum florae nepalensis, *etc.*

*cf.* O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxvii;  
W. T. STEARN, J. Arn. Arb. 26 (1945) 168.  
Date of publication 1 Feb. 1825.

**Don, G.,** Monograph of the genus *Allium* (in Mem. Werner. Nat. Hist. Soc. vol. 6).

*cf.* W. T. STEARN, J. Bot. 74 (1936) 322-323.  
The paper was read to the Society on April 22, 1826, but the title-page of the entire volume is dated 1832. The latter date was accepted by several authors, including E. D. MERRILL (Comm. Loureiro's Fl.). In fact it was published in 1827 and probably early in that year, certainly by May 1827.

**Don, G.,** A general system of gardening and botany: *etc.*

*cf.* T. A. SPRAGUE, Kew Bull. (1925) 311-312.  
The dates given below are derived from notices in Bent's Monthly Literary Advertiser, the Literary Gazette and the library accession records of the Linnean and Horticultural Societies of London (W. T. STEARN *in litt.*).

<i>Vol.</i>	<i>Dates</i>	<i>Vol.</i>	<i>Dates</i>
1	early Aug. 1831	4	probably the greater portion appeared in 1837 and only the last part (contents uncertain) between 8 Mar. & 8 Apr. 1838.
2	Oct. 1832		
3	8-15 Nov. 1834		

Note. Vols 1-3 were issued in 1804; 'vol. 4, 5 and a few copies of 6 were issued in 1805-06;

Note. The first three volumes were first published as entire volumes, then re-issued in parts for

the benefit of the gardeners unable to buy a whole volume at a time, but the fourth volume was first issued in parts, then as an entire volume; unfortunately the contents and dates of these parts are still unknown. SPRAGUE (*l.c.* p. 312-315) gave a list of some of WALLICH's and ROXBURGH's *nomina nuda*, which were validated by descriptions in DON's General system, and of new species and new combinations proposed in the same work.

**Donn, J., Hortus Cantabrigiensis, etc.**  
*cf.* C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1 (1938) 142.  
In July 1798 received by the Gentlem. Magazine (see Review on p. 597).

**Drake del Castillo, E., Illustrationes florae insularum maris pacifici.**  
*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 7 (1939) 202.

Part	Pages	Plates	Approximate date of issue	
1	1-32	1-10	March	1886
2	33-48	11-20	July or Aug.	1886
3	49-64	21-30	June	1887
4	65-80	31-40	May	1888
5	81-104	41-50	July	1889
6	105-216		July	1890
7	217-458		July or Aug.	1892

**Duhamel de Monceau, H. L., Traité des arbres et arbustes, etc.** 2nd ed. ('Nouveau Duhamel').  
*cf.* E. M. TUCKER, J. Arn. Arb. 2 (1921) 181-182; *ibid.* 3 (1922) 227.  
7 Volumes issued in 83 livraisons from 1800-1819. The original work appears to be very rare; it was reissued about 1852 with partly differing title-pages and without dates.

Vol.	Pages	Dates
1	264, iv	1800-01
2	244, v	1804
3	234, iv	1806
4	240, 4	1809
5	330, 4	1812
6	266, 6	1815
7	252, 7	1819

Note. TUCKER has not investigated the contents and dates of issue of the parts, although (according to W. T. STEARN *in litt.*) French journals of this periodical contain many references to them; hence the dates above are approximate only.

**Dumont d'Urville, Voyage de l'Astrolabe.**  
*cf.* A. RICHARD.  
**Dumont d'Urville, Voyage au Pôle Sud . . . sur les corvettes l'Astrolabe et la Zélée.**  
*cf.* HOMBRON & JACQUINOT, and DECAISNE.

**Duperrey, L. J., Voyage autour du monde . . . sur la corvette la Coquille.**  
*cf.* A. TH. BRONGNIART.

**Du Petit-Thouars, A. A., Voyage de la Vénus.**  
*cf.* DECAISNE.

**Du Petit-Thouars, L. M. A., Plantes des îles de l'Afrique australe formant des genres nouveaux, etc.** or alternative titles.  
*cf.* B. B. WOODWARD, J. Bot. 38 (1900) 394; W. P. HIERN, J. Bot. 38 (1900) 492-493.

Part	Plates	Probable dates
1	1-4	1804
2	5-8	1804
	9-12	1805
3	13-18	1806
4	19-24	1807
(94 evidently a printer's error)		

**Du Petit-Thouars, L. M. A., Genera nova madagascariensia, etc.**  
*cf.* B. B. WOODWARD, J. Bot. 38 (1900) 394-395; W. P. HIERN, *ibid.* 493-494.

The date 1806 given by PRITZEL (Thes. Lit. Bot. 1872) seems doubtful. Although the work was composed in 1796, it was probably not printed until 1808. It was reprinted in ROEMER's Collect. Bot. 1809 and in DU PETIT-THOUARS's Mélanges Bot. 1811.

**Du Petit-Thouars, L. M. A., Histoire particulière des plantes Orchidées . . . d'Afrique, etc.**  
*cf.* O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxvii.  
Dated 1822, but in reality issued between 1819 and 1822. Descriptions of the genera were published earlier in Bull. Soc. Philomatique (1809) 314-319.

**Durand, Th. & H. Schinz, Conspectus florae Africae, ou Énumération des plantes d'Afrique.**  
*cf.* W. T. STEARN, J. Soc. Bibl. Nat. Hist. 3 (1954) 13.

Vol.	Part	Pages	Dates
1	2	1-268	June 1898
5	wholly issued	1-957	Jan. 1895

**Ecklon, Ch. F. & K. L. P. Zeyher, Enumeratio plantarum Africae Australis, etc.**  
*cf.* O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxvii; H. S. MARSHALL, J. Soc. Bibl. Nat. Hist. 1, part 4 (1937) 101-103.

Part	Pages	Dates
1	1-144	Dec. 1834? or early 1835
2	145-288	Jan. 1836
3	289-400	Apr. 1837

Note. The date printed on the first page of each sheet probably represents the date when each sheet was printed off; evidently the work was issued in three parts, and not in sheets.

The Leguminosae appeared in Jan. 1836, before those in E. MEYER's *Commentarii* (see there); in general most names of ECKLON & ZEYHER have priority, when compared with those of MEYER in the cited work.

Edwards, S. T., *The Botanical Register: etc.*

cf. E. M. TUCKER, *J. Arn. Arb.* 18 (1937) 183-184.

Vol.	Plates	Dates
1	1-76	Mar.-Dec. 1815
	77-90	Jan.-Feb. 1816
2	91-163	Mar.-Dec. 1816
	164-177	Jan.-Feb. 1817
3	178-248	Mar.-Dec. 1817
	249-263	Jan.-Feb. 1818
4	264-335	Mar.-Dec. 1818
	336-349	Jan.-Feb. 1819
5	350-421	Mar.-Dec. 1819
	422-435	Jan.-Feb. 1820
6	436-506	Mar.-Dec. 1820
	507-520	Jan.-Feb. 1821
7	521-590	Mar.-Dec. 1821
	591-605	Jan.-Feb. 1822
8	606-675	Mar.-Dec. 1822
	676-689	Jan.-Feb. 1823
9	690-762	Mar.-Dec. 1823
	763-777	Jan.-Feb. 1824
10	778-853	Mar.-Dec. 1824
	854-867	Jan.-Feb. 1825
11	868-940	Mar.-Dec. 1825
	941-955	Jan.-Feb. 1826
12	956-1029	Mar.-Dec. 1826
	1030-1043	Jan.-Feb. 1827
13	1044-1116	Mar.-Dec. 1827
	1117-1130	Jan.-Feb. 1828
14	1131-1202	Mar.-Dec. 1828
	1203-1216	Jan.-Feb. 1829
15	1217-1291	Mar.-Dec. 1829
	1292-1305	Jan.-Feb. 1830
16	1306-1376	Mar.-Dec. 1830
	1377-1391	Jan.-Feb. 1831
17	1392-1462	Mar.-Dec. 1831
	1463-1476	Jan.-Feb. 1832
18	1477-1549	Mar.-Dec. 1832
	1550-1564	Jan.-Feb. 1833
19	1565-1637	Mar.-Dec. 1833
	1638-1652	Jan.-Feb. 1834
20	1653-1727	Mar.-Dec. 1834
	1728-1741	Jan.-Feb. 1835
21	1742-1821	Mar.-Dec. 1835
	1822-1828	Jan.-Feb. 1836
22	1829-1919	Feb.-Dec. 1836
23	1920-2014	Jan.-Dec. 1837

An Appendix to the 1st 23 vols, consisting of an index and 9 additional undated coloured plates, was published in 1839.

The volumes were published in parts on the first of each month; each part consisting of 8 plates, often with a double plate counting as two.

Elliott, St., *A sketch of the botany of South Carolina and Georgia.*

cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxviii; J. H. BARNHART, *Bull. Torr. Bot. Club* 28 (1901) 680-688.

Vol.	No	Pages	Plates	Dates
1	1	1-96 +i-ii	1-2	originally issued Sept. 26, 1816; re- called, reprinted and reissued with no 2 (see below) prob. Dec. 1816 March 1817
	2	97-200		Oct. 1817 (illustrat- ing species described in no 1 have been distributed with no 4!)
	3	201-296		1817 (prob. Dec.)
	4	297-400, iii-vi	3-4	1821 (prob. early in the year)
	5	401-496		1821 (prob. late in the year)
	6	497-606		1822 (prob. early in the year)
2	1	1-104		1822?
	2	105-208		1823?
	3	209-312		1823?
	4	313-416		1824
	5	417-520		
	6	521-743	7-12?	

Note. The publication date(s) of pl. 5 and 6 are not known.

Ellis, J., *An historical account of Coffee, etc.*

cf. C. D. SHERBORN, *J. Soc. Bibl. Nat. Hist.* 1 (1938) 141.

In April 1774 received by the *Gentlem. Magazine*.

Elwes, H. J., *A monograph of the genus Lilium.*

cf. W. T. STEARN, in Woodcock & Coutts, *Lilies* (1935) 215-216; WOODCOCK & STEARN, *Lilies of the world* (1950) 396.

Part	Dates
1 with pl. 3, 16, 24, 34, 44, 46, 47, 48, and phot. Himalaya	Mar. 1877
2 with pl. 2, 9, 17, 21, 22, 42, 43, 45	Apr. 1877
3 with pl. 8, 14, 26, 30, 33, 36, 39, 41	Aug. 1877
4 with pl. 6, 7, 23, 25, 29, 31, 32, 38	Dec. 1877
5 with pl. 1, 4, 10, 13, 15, 19, 20, 27	Aug. 1878
6 with pl. 5, 12, 18, 28, 35, 37 but text in part 3, 40	Jan. 1879
7 with pl. 11 but text in part 5, title, dedic., list of contents, etc. pp. xv and map	May 1880

24-33, 1838-1847, each volume comprising an entire year from Jan.-Dec.; the plates of each volume separately numbered.

**Endlicher, S. L., Atakta botanika.** Nova genera et species plantarum descripta et iconibus illustrata.  
*cf.* W. T. STEARN, J. Arn. Arb. 28 (1947) 426.

Part	Pages	Plates	Dates
1	1-6	1-5	1833
2	7-12	6-11	1833 or 1834
3	13-20	12-24	1834
4	21-26	25-40	1835

Note. Plates 10, 26, 28, 37, 38 never published.

**Endlicher, S. L., Genera plantarum, etc.**  
*cf.* O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxviii;  
W. T. STEARN, J. Arn. Arb. 28 (1947) 424-425.

Part	Pages	Dates
1	1-80	prob. Sept. 1836
2	81-160, i-iv	Dec. 1836
3	161-240	June 1837
4	241-320	Oct. 1837
5	321-400	Dec. 1837
6-7	401-560, v-xii	June 1838
8	561-640	Aug. 1838
9	637-720, xiii-xvi	Jan. 1839
10	721-800	Mar. 1839
11	801-880	June 1839
12	881-960, xvii-xx	Nov. 1839
13	961-1040	Feb. 1840
14	1041-1120	Apr. 1840
15	1121-1200	June 1840
16	1201-1280, xxi-xxviii	Aug. 1840
17	1281-1360, xxix-xl	Oct. 1840
18	1361-1483, xli-lx, title, etc.	prob. Feb.-Mar. 1841
Suppl. 1	occupies p. 1335-1427 of the main work and was issued in parts 17 and 18 of this (publ. dates see above).	
Suppl. 2	Mantissa botanica, etc., 114 pp., 1842 (after March).	
Suppl. 3	Mantissa botanica altera, etc., 11 pp., 1843 (after Oct. 4).	
Suppl. 4	Generum plantarum Supplementum quartum, Pars 2, 96 pp., 1847 (according to title-page) or 1848.	
Suppl. 5	Generum plantarum Supplementum quintum (or 4 Pars 3), 104 pp., 1850.	

**Endlicher, S. L., Iconographia generum plantarum.**  
*cf.* W. T. STEARN, J. Arn. Arb. 28 (1947) 425-426.

Part	Plates	Dates
1	1-12	1837
2	13-24	1837
3	25-36	1837
4	37-48,	1838

Part	Plates	Dates
	title, dedic., pp. v-viii	
5	49-60	1838
6	61-72	1839
7	73-84	1839
8	85-96	1839
9	97-108	1840
10	109-125, pp. ix-xvi	1841

**Engler's Botanische Jahrbücher.** See Botanische Jahrbücher.

**Engler, A. & K. Prantl.** Die natürlichen Pflanzenfamilien, etc. Teil 2-4.  
*cf.* W. T. STEARN in MS (will be published with extensive data in J. Soc. Bibl. Nat. Hist.).

Teil	Abt. (vol.)	Lief. (part)	Pages	Dates	
2	1	3	1-96	June 1887	
		8	97-144	June 1887	
		13	145-172	Dec. 1887	
		26	173-240	Feb. 1889	
		27	241-262	Mar. 1889	
	2	7	1-48	July 1887	
		12	49-96	Nov. 1887	
		15	97-130	Jan. 1888	
	3	1	1-48	Mar. 1887	
		5	49-96	June 1887	
		9	97-144	Aug. 1887	
		27-28	145-168	Mar. 1889	
	4	11	1-48	Oct. 1887	
		17	49-78	Mar. 1888	
	5	2	1-48	May 1887	
		6	49-96	June 1887	
		10	97-144	Sept. 1887	
		17	145-162	Mar. 1888	
	6	21	1-48	Oct. 1888	
		22	49-96	Nov. 1888	
		23	97-144	Nov. 1888	
		25	145-192	Jan. 1889	
		27-28	193-224	Mar. 1889	
	3	1	14	1-48	Dec. 1887
			18	49-96	May 1888
			20	97-144	Aug. 1888
			30	145-192	Mar. 1889
32			193-240	May 1889	
		35	241-289	Aug. 1889	
1a		70	1-48	Mar. 1892	
		79	49-96	Mar. 1893	
		87-88	97-130	Aug. 1893	
1b		31	1-48	Apr. 1889	
		33	49-96	May 1889	
2		16	1-48	Feb. 1888	
		19	49-96	July 1888	
		29	97-144	Mar. 1889	
		55	145-192	Mar. 1891	
		57	193-240	Mar. 1891	
		58	241-281	May 1891	
2a		51	1-48	Dec. 1890	
		53	49-96	Jan. 1891	
		56	97-142	Mar. 1891	

<i>Teil</i>	<i>Abt.</i> ( <i>vol.</i> )	<i>Lief.</i> ( <i>part</i> )	<i>Pages</i>	<i>Dates</i>	<i>Teil</i>	<i>Abt.</i> ( <i>vol.</i> )	<i>Lief.</i> ( <i>part</i> )	<i>Pages</i>	<i>Dates</i>	
3	3	24	1-48	Dec. 1888	4	3b	108	145-192	7 Aug. 1894	
		59	49-64	?June 1891			109	193-240	21 Sept. 1894	
		63	65-112	Sept. 1891			115-116	241-336	12 Mar. 1895	
		71	113-160	Apr. 1892			126	337-378	Dec. 1895	
		77	161-208	Nov. 1892		4	61-62	1-96	July 1891	
		90	209-256	Oct. 1893			64	97-144	Sept. 1891	
		101-102	257-352	13 Mar. 1894			66	145-194	Nov. 1891	
		104-105	353-396	22 May 1894		5	34	1-48	June 1889	
	4	47	1-48	Aug. 1890			36	49-80	Sept. 1889	
		52	49-94	Dec. 1890			39	81-128	Feb. 1890	
		131-132	95-190	Mar. 1896			43	129-176	May 1890	
		133	191-238	Apr. 1896			48	177-224	Aug. 1890	
		135	239-286	May 1896			54	225-272	Dec. 1890	
		138-139	287-362	June 1896					or Jan. 1891	
	5	42	1-48	May 1890			74	273-304	July 1892	
		44	49-96	June 1890			87	305-321	Aug. 1893	
		59	97-128	?June 1891			89	322-368	Sept. 1893	
		73	129-176	July 1892			104-105	369-402	June 1894	
		78	177-224	Dec. 1892						
		84	225-272	May 1893						
		117	273-320	2 Apr. 1895						
		118	321-368	7 May 1895						
		128	369-416	Jan. 1895						
		136	417-468	?Apr. 1896						
	6	49-50	1-96	Sept. 1890			178-179	1-160	Aug. 1898	
		80	97-144	Mar. 1893			182-183	161-320	Dec. 1898	
		82	145-192	May 1893			184-185	321-462, i-viii	Mar. 1899	
		95	193-240	7 Nov. 1893						
		113	241-288	19 Feb. 1895						
		119	289-340	14 May 1895						
	6a	98-99	1-96	28 Dec. 1893						
		100	97-144	27 Feb. 1894						
		103	145-192	18 Apr. 1894						
		106-107	193-254	10 July 1894						
	7	72	1-48	July 1892		1	155-156	1-96	July 1897	
		81	49-96	Apr. 1893			157-158	97-192	Aug. 1897	
		87-88	97-160	Aug. 1893			161-162	193-288	Oct. 1897	
		94	161-208	24 Oct. 1893			163	289-336	Oct. 1897	
		96	209-241	21 Nov. 1893			165	337-380	Nov. 1897	
	8	111	1-48	28 Dec. 1894		2	—	1-84	Sept. 1900	
		153	49-96	?Apr. 1897		3	1	1-96	Mar. 1906	
		164	97-144	Dec. 1897			2	97-192	Oct. 1906	
		171	145-192	Mar. 1898			3	193-288	Apr. 1907	
		175-176	193-274	July 1898			4	289-379	Jan. 1908	
4	1	37	1-48	Oct. 1889		4	3	1	1-96	Apr. 1914
		38	49-96	Dec. 1889				2	97-192	June 1914
		45	97-144	?June 1890				3	193-288	Jan. 1915
		69	145-183	Dec. 1891					or Dec. 1914	
	2	75	1-48	Aug. 1892				4	289-381	Sept. 1915
		120-121	49-144	June 1895						
		122	145-192	July 1895						
		123-125	193-310	Oct. 1895						
	3a	68	1-48	Dec. 1891						
		85	49-96	June 1893						
		114	97-176	26 Feb. 1895						
		127	177-224	Dec. 1895						
		134	225-272	Apr. 1896						
		140	273-320	Nov. 1896						
		146-147	321-384	Feb. 1897						
	3b	65	1-48	Oct. 1891						
		67	49-96	Nov. 1891						
		83	97-144	May 1893						

Gesamtregister zum 2. bis 4. Teil ( <i>Index</i> ).				
	<i>Lief.</i> ( <i>part</i> )	<i>Pages</i>	<i>Dates</i>	
	178-179	1-160	Aug. 1898	
	182-183	161-320	Dec. 1898	
	184-185	321-462, i-viii	Mar. 1899	
Nachträge zum 2. bis 4. Teil ( <i>Appendices</i> ).				
<i>Nachtr.</i>	<i>Ergän- zungsheft</i>	<i>Lief.</i> ( <i>part</i> )	<i>Pages</i>	<i>Dates</i>
1		155-156	1-96	July 1897
		157-158	97-192	Aug. 1897
		161-162	193-288	Oct. 1897
		163	289-336	Oct. 1897
		165	337-380	Nov. 1897
2	1	—	1-84	Sept. 1900
3	2	1	1-96	Mar. 1906
		2	97-192	Oct. 1906
		3	193-288	Apr. 1907
		4	289-379	Jan. 1908
4	3	1	1-96	Apr. 1914
		2	97-192	June 1914
		3	193-288	Jan. 1915
			or Dec. 1914	
		4	289-381	Sept. 1915

Fabricius, Ph. C., *Enumeratio methodica plantarum horti medici Helmstadiensis, etc.*  
*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxviii.  
Three editions, respectively in 1759, 1763, and 1776. As regards the edition of 1763, ADANSON's names have priority.

Fauché, M., A. Brongniart, Chaubard & Bory de Saint-Vincent, *Expédition scientifique de Morée*. Vol. III, part 2. *Botanique*.  
*cf.* C. D. SHERBORN & B. B. WOODWARD, *Ann. Mag. Nat. Hist.* VII. 8 (1901) 335-336.

It appears likely that up to p. 336 (out of 367 pp.) was out in 1832, and the remainder in 1833.  
An Atlas, 38 pl., was issued in 1835.

**Fernandez-Villar, C. & A. Naves, Novissima appendix etc.**

cf. E. D. MERRILL, Philip. J. Sc. C. Bot. 12 (1917) 114–115.

This is published as fasc. 13A–23A of BLANCO'S Flora de Filipinas, 3rd edition.

Part	Nov. App. pages	Dates
13A–21A	1–272	1880
22A–23A	273–336	1882
(24A, unnumbered)	337–375	June 15,
'Entrega ultima'		1883

**Fielding, H. B. & G. Gardner, Sertum plantarum.**

According to W. T. STEARN (*in litt.*) this was published as follows:

Part	Plates	Dates
1	1–25	1843 (rec. by Linnean Soc. on 23 Nov. 1843)
2	26–50	1844 (rec. Linn. Soc. 11 Mar. 1844)
3	51–75	1844 (rec. Linn. Soc. 26 Aug. 1844)

**The Florists' Magazine.**

cf. J. BRITTEN, J. Bot. 56 (1918) 237–238.  
Vol. 1, no 1, July 1835.

It was to be issued monthly. Only vol. 1 and 2 parts of vol. 2 (the last in Sept. 1836) appeared.

Originally issued in quarto size; subsequently the whole work was issued in smaller size as one volume, dated 1836, 'vol. 1' having been removed from the title-page: in this the pagination is sometimes omitted.

**Franchet, A. R. & P. A. L. Savatier, Enumeratio plantarum in Japonica sponte crescentium.**

cf. W. T. STEARN, J. Bot. 78 (1940) 283–284; T. NAKAI, J. Jap. Bot. 17 (1941) 425–426.

Vol.	Part	Pages	Dates
1	1	i–xv, 1–192	4 Nov. 1873
	2	193–486	1875 (prob. Oct.)
2	1	1–256	Jan. 1877
	2	257–624	1878 (prob. Apr.)
	3	625–789	26 Apr. 1879

Note. As noted by FRANCHET himself (*op. cit.* 2, p. 646), names published by MAXIMOWICZ in Bull. Ac. Sc. St Pétersb. 23 (Feb. 1877) 305–391 have priority over names in FRANCHET & SAVATIER, Enum. vol. 2 pt 2 (1878, before May; cf. J. Bot. 16, p. 158).

**Gaertner, J., De fructibus et seminibus plantarum.**

cf. W. ROTHMALER, Chron. Bot. 5 (1939) 438; B. L. BURTT, Kew Bull. (1951) 148.

Vol. 1 antedates LAMARCK'S Encyclopédie vol. 3<sup>1</sup>; vol. 2 antedates LAMARCK'S vol. 3<sup>2</sup>.

**Gaudichaud-Beaupré, Ch., Botanique** (in L. DE FREYCINET, Voyage . . . sur l'Uranie et la Physicienne).

cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 7 (1901) 392; J. Bot. 39 (1901) 206.

Part	Pages	Dates
1	1–48	Oct. 1826
2	49–88	Dec. 1826
3	89–128	Feb. 1827
4	129–168	June 1827
5	169–216	Sept. 1827
6	217–264	Feb. 1828
7	265–312	Aug. 1828
8	313–360	Dec. 1828
9	361–400	July 1829
10	401–432	Sept. 1829
11	433–464	Sept. 1829
12	465–522	Mar. 1830

**Gaudichaud-Beaupré, Ch., Botanique du voyage . . . sur la corvette La Bonite.**

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxviii; C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 7 (1901) 391; J. Bot. 39 (1901) 206; I. M. JOHNSTON, J. Arn. Arb. 25 (1944) 481–487.

Introduction, 1851. According to JOHNSTON (*l.c.* p. 487) the Atlas, containing 150 plates, is issued as follows:

Part	Plates	Dates
1	1–30	1841
2		
3		
4	31–40	1841
5	41–50	1842
6	51–60?	1842
7	141–150! (crypt.)	1843
8	61–70!	1843
9	136–140? (crypt.)	1844
10	71–80!	1844
11	Hydroids (1–6)!	1844
12	81–91!	1844
13	91–100	1847–48
14	131–135?	1845–50
15		
16		
17		
18	101–106	1851
19		
20		
21		
22	119–124	1852
23	125–130	1852
24	title-page	1852

Explication et description des planches de l'Atlas par C. d'ALLEIZETTE, 1866.

Note. The plates have analytic details in great abundance, and according to the Rules the new species are legitimately published.

Gay, Cl., *Flora de Chile* (in Hist. Fis. Polit. Chile).  
cf. I. M. JOHNSTON, *Darwiniana* 5 (1941) 154-165.

Vol.	Part	Pages	Dates
1 (1845)	1	1-104	before Dec. 1845
	2	105-248	early in 1846
	3	249-376	before Oct. 1846
	4	377-496	before Oct. 1846
2 (1846)	1	1-144	before May 1847
	2	145-272	before May 1847
	3	273-416	May or June 1847
	4	417-534	May or June 1847
3 (1847)	1	1-128	before Feb. 1848 (possibly late in 1847)
	2	129-240	before June 1848
	3	241-384	late 1848?
	4	385-484	prob. late 1848 or early 1849
4 (1849)	1	1-128	before Aug. 1849
	2	129-256	before Aug. 1849
	3	257-384	possibly before Aug. 1849
	4	385-516	possibly before Aug. 1849
5 (1849)	1	1-128	late 1849
	2	129-256	late 1849
	3	257-384	prob. 1851 or 1852
	4	385-479	middle of 1852
6 (1853)			issued complete, probably after the middle of 1854, and not earlier than middle of 1853!
7 (1850)	1-4		in 4 entregas, the final one (pp. 385-515) before May 22, 1854
8 (1852)			issued complete, probably early in May 1854

Der Gesellschaft naturforschender Freunde zu Berlin, etc. Neue Schriften 4, 1803.

See sub MÜHLENBERG & WILLDENOW.

Gmelin, J. F., *Systema naturae*. 2<sup>2</sup> (1791).

cf. O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 155.

In this volume plates 120 and 125 of GAERTNER's *De fructibus et seminibus plantarum* vol. 2 (1791) are cited. So GAERTNER vol. 2 has priority over Gmelin, *Syst. nat.* 2<sup>2</sup>.

Godron, D. A., *Florula Juvenalis*, etc.

cf. O. STAPP, *Bot. Magaz.* 155 (1932) sub t. 9267.

Appeared in or before May 1853.

Gouan, A., *Hortus regius Monspelienis*, etc.

cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxix.

Published in 1762; erroneously mentioned as 1768 in PRITZEL *Thes. Lit. Bot.*

Gray, Asa, *Botanical contributions and Contributions to North American botany* (in *Proc. Amer. Acad. Arts & Sc.* 1846-1888).

cf. J. EWAN, *Amer. Midl. Nat.* 22 (1939) 218-222.

Vol. of Proc.	Pages	Dates on title-page	Dates of issue
1	46-50	1848	Dec. 1846 or Jan. 1847
2	397-398 438-444 159-160 323-325	1850 1850 1852 1852	1849 1849 24 May 1852 24 May 1852
3	48-54 127-129 94-97	1857 1853 1857	1853 May 1854 May 1854
4	98-99 33-50 306-318 319-324 326-327 363-366	1860 1860 — — 1860 1860	(?) 1858 Apr. 1858 Sept. 1859 Sept. 1859 Oct. 1859 1860
5	114-146 146-152 153-173 174-190 190-191 314-321 321-352	1862 1862 1862 1862 1862 1862 1862	1861 1861 (?) 1861 (?) 1861 (?) 1861 Jan. 1862 Jan. 1862
6	37-55 55-56 56-76 77-80 182-188 188-236 519-556	1866 1866 1866 1866 1864 1864 1865	1862 1862 1862 1862 Jan. 1864 Jan. 1864 Nov. 1865
7	327-344 345-401	1868 1868	Mar. 1868 July 1868
8	145-200 243-296 365-412 620-631 631-661 620-661	1870 1870 1872 1873 1873 1873	Apr. 1870 31 Dec. 1870 May 1872 18 Nov. 1873 18 Nov. 1873 18 Nov. 1873
9	187-218	1874	May 1874
10	39-78 312-332	1874 1875	25 Dec. 1874 Apr. 1875
11	71-104	1876	5 Jan. 1876
12	51-84 159-165	1876 1877	27 Dec. 1876 May 1877
13	361-374	1878	5 Apr. 1878
15	25-52	1879	1 Oct. 1879
16	78-108	1880	1 Sept. 1880
17	163-230	1882	26 June 1882
19	1-96	1883	30 Oct. 1883
20	1-7 8-12 257-310	1884 1884 1885	(?) 1884 (?) 1884 26 Jan. 1885
21	363-413	1886	4 Apr. 1886
22	270-314	1887	4 Mar. 1887
23	223-227	1888	19 Apr. 1888



Note. The titles of the respective papers are mentioned in the *Amer. Midl. Nat. l.c.*, but have not been copied here.

**Grenier, J. C. M. & D. A. Godron, *Flore de France*, etc.**

According to W. T. STEARN (*in litt.*), first published in 6 parts.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1 (1848)	1	1-330	1847 (Nov.)
	2	331-762	1849 (Jan.)
2 (1850)	1	1-392	1850 (prob. Nov.)
	2	393-760	1853 (prob. Apr.)
3 (1855-56)	1	1-384	1855 (prob. May)
	2	385-779	1856 (Sept., <i>fide</i> KIRSCHLEGER)

**Grisebach, H. R. A., *Spicilegium florae rumelicae*, etc.**

*cf.* I. M. JOHNSTON, *J. Arn. Arb.* 34 (1953) 264.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	1-160	1843 (June?)
	2-3	161-407	Dec. 1843 or Jan. 1844
2	4	1-160	1844 (July?)
	5-6	161-548	Dec. 1845 or Jan. 1846

**Grisebach, H. R. A., *Flora of the British West Indian Islands*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 155;  
B. D. JACKSON, *J. Bot.* 30 (1892) 347; I. URBAN,  
*Symb. Antill.* 1 (1898) 56.

<i>Part</i>	<i>Pages</i>	<i>Dates</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1-96	1859	4-5	315-506	1861
2	97-192	1859	6-7	507-789	1864
3	193-314	1860			

**Grisebach, H. R. A., *Plantae Lorentzianae* (in *Abh. Ges. Göttingen* 19, 1874).**

*cf.* L. CROIZAT, *Darwiniana* 5 (1941) 422, note 1.  
Released from the press not earlier than Dec. 1874, and almost certainly in the first half of Dec.

**Guillemin, J. A., Perrottet, S., & A. Richard, *Florae Senegambiae tentamen*.**

Only one volume was published of this work. The dates of publication, as ascertained by W. T. STEARN from contemporary reviews, are as follows:

<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1	1-40	1-8	Jan. 1831
2	41-80	9-18	1831 (prob. Apr.)

<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
3	81-120	19-28	1831 (prob. June)
4	121-160	29-38	Sept. 1831
5	161-200	39-48	Jan. 1832
6	201-240	49-58	1832 (prob. June or July)
7	241-280	59-66	Oct. 1832
8	281-316, index, title, dedication, i-ix	67-72	1833 (prob. Apr.)

**Halácsy, E. von, *Conspectus florae graecae*.**

Published in 7 parts as follows (W. T. STEARN *in litt.*):

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	1-224	Feb. 1900
	2	225-576	Oct. 1900
	3	577-825	Oct. 1901
2	1	1-256	Mar.-Apr. 1902
	2	257-612	Oct.-Nov. 1902
3	1	1-320	Mar. 1904
	2	321-519, i-xxv	Oct.-Nov. 1904
Suppl.	1	1-132	June 1908
Suppl.	2	(published in Magyar Bot. Lapok 11, 1912, 114-202)	Oct. 1912

**Harvey, W. H. & O. W. Sonder, *Flora capensis*.**

*cf.* H. S. MARSHALL, *J. Soc. Bibl. Nat. Hist.* 1, part 7 (1939) 195-196.

<i>Vol.</i>	<i>Dates</i>
1	May (after the 10th) 1860
2	Oct. (after the 15th) 1862
3	(between Feb. 24 and July) 1865

Note. From vol. 4 onwards (in total the *Flora* comprises 7 vols and a Suppl. to Vol. 5, sect. 2) the dates of publication are clearly given at the beginning of each volume.

**Hasskarl, J. K., *Catalogus plantarum in horto Bogoriensi*, etc.**

*cf.* W. H. DE VRIESE, *Tijdschr. Nat. Gesch. & Phys.* 12 (1845) 60; *Fl. Mal. Bull. no* 10 (1953) 363.  
Was published in Oct. 1844.

**Haworth, A. H., *Supplementum plantarum succulentarum*, etc.**

*cf.* W. T. STEARN, *J. Bot.* 76 (1938) 114.  
The work is rightly dated May 1819.

**Hayek, A. von, *Prodromus florae peninsulae Balcanicae* (in *FEDDE, Rep. Beih.* 30).**

*cf.* W. T. STEARN, *J. Soc. Bibl. Nat. Hist.* 1, part 4 (1937) 117-119.

Vol.	Part	Pages	Date of issue	Receipt at Kew	No	Pages	Plates	Dates
1	1	i-viii, 1-160	Apr. 1, 1924	(May 3, 1924)	58	1-153	1-40	10 Oct. 1929
					58A	157-325	41-159	1 July 1932
	2	161-352	Aug. 25, 1924	(Sept. 5, 1924)	<b>Herbert, W., An Appendix, etc.</b> (mostly bound up in vol. 48 of the Botanical Magazine). <i>cf.</i> J. R. SEALY, Kew Bull. (1939) 66; W. T. STEARN, J. Soc. Bibl. Nat. Hist. 2 (1952) 375-376. Probably published in Dec. 1821, certainly between Oct. 1821 and 1 Jan. 1822.			
	3	353-512	Feb. 15, 1925	(Feb. 28, 1925)				
	4	513-672	Dec. 15, 1925	(Dec. 31, 1925)				
	5-6	673-960	Oct. 15, 1926	(Oct. 25, 1926)				
	7-8	961-1193	June 30, 1927	(July 7, 1927)				
2	1	1-96	Nov. 24, 1928	(Dec. 3, 1928)	<b>Herbert, W., Amaryllidaceae, etc.</b> <i>cf.</i> W. T. STEARN, J. Soc. Bibl. Nat. Hist. 2 (1952) 376-377. Not published before 2 Apr. 1837, but received by the Horticultural Society on 2 May 1837, so probably issued at the end of April 1837.			
	2	97-240	July 20, 1929	(July 31, 1929)				
	3	241-336	Nov. 15, 1929	(Dec. 16, 1929)				
	4	337-576	Oct. 15, 1930	(Oct. 31, 1930)				
	5	577-768	Feb. 15, 1931	(Mar. 11, 1931)				
	6	769-960	Sept. 20, 1931	(Oct. 12, 1931)	<b>Héritier de Brutelle, Ch. L. L'.</b> <i>cf.</i> under letter L.			
	7	961-1152	Dec. 31, 1931	(Jan. 15, 1932)				
3	1	1-208	Aug. 15, 1932	(Sept. 19, 1932)				
	2	209-368	Dec. 20, 1932	(Jan. 2, 1933)				
	3	369-472	Mar. 31, 1933	(Apr. 6, 1933)				

**Hegi, G., Illustrierte Flora von Mittel-Europa.**  
*cf.* A. BECHERER, Candollea 5 (1934) 342-344.  
The work consists of 7 volumes, bound in 13. It contains a great number of new combinations in infra-specific taxa of European plants. It is not of special importance for Malaysian botany; therefore, the dates given by BECHERER are not copied here.

**Hempel, G. & K. Wilhelm, Bäume und Sträucher des Waldes.**  
*cf.* E. M. TUCKER, J. Arn. Arb. 2 (1922) 236-237.

Abth.	Lieferung	Pages	Dates
	(part)		
1	1	1-32	1889
	2	33-56	1889
	3	57-80	1890
	4	81-96	1890
	5	97-128	1891
	6	129-152	1892 (possibly 1891)
	7	153-176	1892
	8	177-200	1893
2	9	1-16	1893
	10	17-40	1894
	11	41-64	1895
	12	65-88	1895
	13	89-112	1896
	14-15	113-148	1897
3	16	1-24	1898 (probably)
	17	25-48	1898
	18	49-72	1899
	19	73-96	1899
	20	97-140	1899

**Henrard, J. Th., A critical revision of the genus Aristida, etc.** (in Med. Rijksherb. Leiden).

No	Pages	Dates	No	Pages	Dates
54	1-220	1926	54B	465-701	1928
54A	221-464	1927	54C	703-747	1933
				(Suppl.)	

**Henrard, J. Th., A monograph of the genus Aristida.** (in Med. Rijksherb. Leiden).

Part	Plates	Dates
1	1-5	first half of 1844
	Crypt.	
2	1-3	
	Monocot. Phanér.	
	1-2	
	Monocot. Crypt.	
3	6-10	
	Crypt.	
4	3, 4	
	Monocot. Crypt.	
	1-2	
	Dicot. Phanér.	
5	11-14, 16	
	Crypt.	
6	3 bis	
	Crypt.	
	3, 5, 6, 10	
	Dicot. Phanér.	
7	5, 17-20	26 July 1844
	Crypt.	
8	4	17 Jan. 1845
	Monocot. Phanér.	
	4, 7-9	
	Dicot. Phanér.	12 June 1845
9	11, 12, 14, 15, 19	
	Dicot. Phanér.	

Part	Plates	Dates
10	13, 16, 20-22 Dicot. Phanér.	14 Feb. 1846
11	24-28 Dicot. Phanér.	6 July 1848
12	17, 29, 30, 31 Dicot. Phanér.	?
13	5, 6, 7, 8 Monocot. Phanér. 18, 22bis, 23 Dicot. Phanér. Titre et Table	5 May 1853

Note. The contents of the fascicles is copied from JACKSON with some slight alterations (in livr. 6 he included Monocot. Phanér. pl. 6, which certainly must be Dicot. Phanér. pl. 6; in livr. 12, pl. 27 is altered to 29).

The dates given by JACKSON are those of receipt at the British Museum. For livr. 7-13 they are probably correct, but certainly not for livr. 1-6, which are already reviewed in Hook. J. Bot. l.c. 1844. As livr. 7-8 was reviewed in Hook. Lond. J. Bot. 1845 l.c., the first six fascicles must have been issued before July 1844.

In JACKSON's paper a complete list of the depicted plants is included.

The vascular plants were described by J. DECAISNE (see there).

#### Hooker, J. D., *Flora antarctica*.

cf. B. D. JACKSON, J. Bot. 50 (1912) 284; F. G. WILTSHEAR, J. Bot. 51 (1913) 356-357.

Part	No	Pages	Plates	Dates
1	1	i-xii, 1-16	1-8 +chart	1 June 1844
	2	17-32	9-16	before 4 July 1844
	3	33-48	17-24	before 16 Aug. 1844
	4	49-64	25-32	before 14 Oct. 1844
	5	65-80	33-40	
	6	81-92	41-48	before 2 Dec. 1844
	7	93-112	49-56	before 4 Jan. 1845
	8	113-144?	57-64	before 25 Mar. 1845
	9	145?-184	65-72	
	10	185-208, ded.	73-80	May 1845
2	11	209-224	81-88	before 7 Oct. 1845
	12	225-240	89-96	1 Nov. 1845
	13	241-256	97-104	before 4 Dec. 1845
	14	257-272	105-112	before 2 Feb. 1846
		(107 bis & ter)		
	15	273-288	113-120	before 2 Mar. 1846
	16	289-304	121-128	before 4 Apr. 1846
	17	301bis-316	129-136	before 5 May 1846
	18	317-332	137-144	before 1 June 1846
	19	333-348	145-152	before 1 Aug. 1846
	20	349-364	153-160	before 3 Nov. 1846
	21	365-380	161-168	before 5 Dec. 1846
	22	381-396	169-176	before 1 Jan. 1847
	23	397-428	177-184	before 2 Feb. 1847
	24	429- ?	185-192	before 3 May 1847
	25	? -574	193-198	before 2 Oct. 1847

#### Hooker, J. D., *Flora Novae Zelandiae*.

cf. B. D. JACKSON, Bull. Herb. Boiss. 1 (1893) 299; reprinted in J. Bot. 47 (1909) 106; F. G. WILTSHEAR, J. Bot. 51 (1913) 357.

#### Flowering plants.

Part	No	Pages	Plates	Received in British Museum
1	1	1-80	1-20	2 July 1852
	2	81-160	21-40	2 Sept. 1852
	3	161-240	41-60	17 Feb. 1853
	4	241-312	61-70	6 Dec. 1853
		{ Introductory essay, i-xxxix, title, etc.		

#### Flowerless plants.

Part	No	Pages	Plates	Received in British Museum
1	5	1-80	71-90	2 May 1854
	6	81-160	91-110	3 July 1854
	7	161-272	111-130	13 Feb. 1855
	8	273-378	title, etc.	

#### Hooker, J. D., *Illustrations of Himalayan plants, etc.*

cf. W. T. STEARN, Ann. R. Bot. Gard. Calc. 150th Annivers. vol. (1942) 115.

Appeared late July 1855.

#### Hooker, J. D., *Flora Tasmaniae*.

cf. B. D. JACKSON, Bull. Herb. Boiss. 1 (1893) 299; reprinted in J. Bot. 47 (1909) 107; F. G. WILTSHEAR, J. Bot. 51 (1913) 358.

Vol.	No	Pages	Plates	Received in British Museum
1	1	1-80	1-20	5 Nov. 1855
	2	81-160	21-40	7 May 1856
	3	161-240	41-60	2 Dec. 1856
	4	241-320	61-80	6 Aug. 1857
	5	321-359	81-100	3 Dec. 1857
2	6	1-80	101-120	1 July 1858
	7	81-160	121-140	9 Sept. 1858
	8	161-240	141-160	3 Mar. 1859
	9	241-320	161-180	18 Aug. 1859
	10	321-422	181-200	6 Feb. 1860
	11	i-cxxviii, 1-18, titles etc.		1860

#### Hooker, J. D., *Flora of British India*. Vol. 7.

cf. W. T. STEARN, Fl. Mal. Bull. no 10 (1953) 363.

Vol. 7 is dated 1897. However, this volume appeared in 3 parts, viz:

Vol.	Part	Pages	Dates
7	21	1-224	late April 1896
	22	225-422	early Dec. 1896
	23	i-viii, 423-842	early Dec. 1897

#### Hooker, W. J., *Exotic flora, etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxx;

W. T. STEARN in unpublished provisional survey (Apr. 1951).

<i>Vol.</i>	<i>Part</i>	<i>Plates</i>	<i>Supposed probable dates</i>
1 (dated 1823)	1	1-17	Aug. 1822
	2	18-33	Dec. 1822
	3	34-48	1823 (early?)
	4	49-63	1823 (Nov or Dec.?)
	5	64-79	Jan. 1824
2 (dated 1825)	6	80-84	
	7	85-89	Feb. 1824
	8	90-94	Mar. 1824
	9	95-99	Apr. 1824
	10	100-104	May 1824
	11	105-109	June 1824
	12	110-113	July 1824
	13	114-118	Aug. 1824
	14	119-123	Sept. 1824
	15	124-127	Oct. 1824
	16	128-132	Nov. 1824
	17	133-137	Dec. 1824
	18	138- ?	Jan. 1825
3 (dated 1827)	19	?	Feb. 1825
	20	? -150	Mar. 1825
	22-25	151-167? or 170?	1825
	26-28	168? or 171?-187? or 190?	1825 or 1826
	29-34	188? or 191?-212? or 215?	1826
	35-37	213? or 216?-227? or 228?	1826 or 1827
	38	228? or 229?-232	1827

In the indices of the volumes can be found that volume I and II together comprise parts I-XX, and the third volume parts XXII-XXXVIII; evidently part XXI is non-existing. The combined index to the first and second volume at Leyden is bound up with vol. I; it covers plates 1-150 (as STEARN gives for I + II). The second volume at Leyden, however, contains plates 80-162, this not merely being a matter of misbinding, for the text pages going with plates 151-163 have vol. II printed on them! The third volume at Leyden comprises plates 163 (this number by mistake have been used twice) -232; at the bottom of the text pages is printed vol. III. This may explain that KUNTZE (*l.c.*) mentioned vol. II to contain plates 80-163. MERRILL & WALKER in *Bibliogr. East. Asiat. Bot.* (1938) gave the following contents of the work: vol. I, pl. 1-79; vol II, pl. 85-177; vol. III, pl.

178-232; it seems possible that the copy at the Arnold Arboretum or in the U.S. Nat. Herbarium lacked several plates, but even than it is not explained why they gave pl. 177 as the end of vol. II.

Perhaps it is worthwhile to mention that the work does not contain 232 plates, as some plates have two numbers, *i.e.* 3, 4; 41, 42; 47, 48; 90, 91; 155, 156. This, considered with the twice using number 163, makes the total number of plates 228. Mr STEARN finds his data 'scanty'.

#### Hooker, W. J., *Botanical Miscellanies*.

*cf.* H. S. MARSHALL, *Kew Bull.* (1936) 85-95 (incl. list of new genera and species).

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1 (1830)	1	1-96 (95-96 cancelled)	1-25	Apr. 1829
	2	95-236	26-50	Sept. 1829
	3	237-356	51-75	spring or summer 1830
2 (1831)	4	1-128	suppl. 1-10	Nov. or Dec. 1830
	5	129-256	76-95	summer 1831
	6	257-416	suppl. 11-19	(before 11 June)
3 (1853)	7	1-128	suppl. 21-32	before 3 Mar. 1832
	8	129-256	96-112	1 Aug. 1832
	9	257-390	suppl. 33-41	1 Mar. 1833

Note. Suppl. pl. 20 was never published. The dates of parts 5-7 were left uncertain by MARSHALL. A review of parts 5 and 6 in *Literary Gazette* (June 1831) 377 shows that they were issued together in the summer of 1831, while part 7 reviewed in *Literary Gazette* (March 1832) 135 was evidently issued early in 1832 (W. T. STEARN *in litt.*).

#### Hooker, W. J., *Flora boreali-americana, etc.*

*cf.* B. D. JACKSON, *Bull. Herb. Boiss.* 1 (1893) 298; reprinted in *J. Bot.* 47 (1909) 106; C. D. SHERBORN, *J. Soc. Bibl. Nat. Hist.* 1 (1939) 197.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	1-48	1829 (Sept. received by the Gentlem. Magazine)
	2-3	49-144	1830
	4-6		1834
2	7		1834
	8	49-96	July-Aug. 1837 (Bent's Monthl. (Lit. Adv.)
	9	97-144	July 1838
	10	145-192	1 Jan. 1839
	11	193-241	15 Nov. 1839
	12	241 to end	8 July 1840

Hooker, W. J., *Companion to the Botanical Magazine*.  
cf. T. A. SPRAGUE, *Kew Bull.* (1933) 362–364.

Vol.	No	Pages	?Plates (uncertain)	Dates
1	1	1–32	1–2	1 Aug. 1835
	2	33–64	3	1 Sept. 1835
	3	65–96	4–5	1 Oct. 1835
	4	97–128	6–7	1 Nov. 1835
	5	129–160	8	1 Dec. 1835
	6	161–192	9–10	1 Jan. 1836
	7	193–224	11	1 Feb. 1836
	8	225–256	12–13	1 Mar. 1836
	9	257–288	14–15	1 Apr. 1836
	10	289–320	16	1 May 1836
	11	321–352	17–18	1 June 1836
	12	353–384	19	1 July 1836
2	13	1–32	20–21	1 Aug. 1836
	14	33–64	22	1 Sept. 1836
	15	65–96	23	1 Oct. 1836
	16	97–128	portr.	1 Nov. 1836
	17	129–160	24	1 Dec. 1836
	18	161–192	25	1 Jan. 1837
	19	193–224	26	1 Feb. 1837
	20	225–256	27 & portr.	1 Mar. 1837
	21	257–288	28	1 Apr. 1837
	22	289–320	29 & portr.	1 May 1837
	23	321–352	30	1 June 1837
	24	353–381	31–32	1 July 1837

Note. According to SPRAGUE only the dates of publication of the text can be taken into account for priority questions, as those of the plates are not known with certainty.

Hooker, W. J., *The Journal of Botany*, being a second series of the *Botanical Miscellany*; etc.

Vol.	Nos	Dates
1	1–8	1834–1839
2	9–16	Feb.–Sept. 1840
3	17–	Oct. 1840–May 1841
4		June– 1842

Hooker, W. J., *The London Journal of Botany*, etc.

Vol.	Dates	Vol.	Dates
1	1842	5	1846
2	1843	6	1847
3	1844	7	1848
4	1845		

Hooker, W. J., *Journal of Botany and Kew Garden Miscellany*.

Vol.	Dates	Vol.	Dates
1	1849	6	1854
2	1850	7	1855
3	1851	8	1856
4	1852	9	1857
5	1853		

Hooker, W. J. & G. A. Walker-Arnott, *The botany of Captain Beechey's voyage*, etc.  
cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxx;  
B. D. JACKSON, *J. Bot.* 31 (1893) 297; H. S. MARSHALL, *Kew Bull.* (1950) 333; W. T. STEARN *in litt.*

Part	Pages	Dates	Part	Pages	Dates
1	1–48	1830	8	337–384	1839 (by 17 Sept.)
2	49–96	1832	9	385–432	1840 (by 7 Aug.)
3	97–144	1832	10	433–?	1841 (by 28 Aug.)
4	145–192	1833	11	?	1841 evidently
5	193–240	1837 (July–Aug.)	12	?	1841 evidently
6	241–288	1838 (July)			
7	289–336	1838 or 1839			

Hudson, W., *Flora anglica*.  
cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxi.  
Appeared early in 1762, before LINNÉ's *Species plantarum* 1762 (HUDSON being cited in the latter).  
2nd edition 1778; 3rd edition 1798 (unrevised, except for some printer's errors).

Humboldt, F. A. von & A. Bonpland, *Plantae aequinoctiales* or *Plantae équinoxiales*, etc.  
cf. C. D. SHERBORN & B. B. WOODWARD, *J. Bot.* 39 (1901) 203.

Vol.	Part	Pages	Number of plates	Dates
1	1	1–8	2	1805
	2	9–38	10	1805
	3	39–72	10	1806
	4	73–106	11	1806
	5	107–138	9	1807
	6	139–170	9	1808
	7	171–202	49–57	1808
	8	203–232	58–65	1808
2	9	title-page to vol. 2, double frontispiece & 1–20	66–68	1808
	10	21–36	74 & 81	1809
	11			
	12			
	13	already published –88		Nov. 1811
	14	89–104	106–113	Apr. 1812
	15	105–124	8	Feb. 1813
	16	125–152	8	Sept. 1813
	17	153–191	11	June 1817

Humboldt, F. A. von & A. Bonpland, *Monographia Melastomacearum*, etc.  
cf. C. D. SHERBORN & B. B. WOODWARD, *J. Bot.* 39 (1901) 203.  
*Vol.* 1: *Melastomae*; *Vol.* 2: *Rhexiae*.



**Jacquin, J. F. von, *Eclogae plantarum rariorum aut minus cognitarum*.**  
*cf. B. B. WOODWARD, Catalogue Books Brit. Mus. (Nat. Hist.) 2 (1904) 917.*

Vol.	Part	Dates
1	1	Oct. 1811
	2	Dec. 1811
	3-4	Mar. 1812
	5-6	Nov. 1813
	7-8	Feb. 1815
	9-10	Aug. 1816
	2	1844

**Jacquin, J. F. von, *Eclogae graminum rariorum aut minus cognitarum, etc.***  
*cf. B. B. WOODWARD, Catalogue Books Brit. Mus. (Nat. Hist.) 2 (1904) 918.*

Part	Pages	Plates	Dates
1	1-16	i-x	1813
2	17-32	xi-xx	1814
3-4	33-64	xxi-xl	1820

**Note.** The remainder, under the editorship of FENZL, appeared in 1844.

**Jacquin, N. J., *Observationum botanicarum iconibus, etc.***  
*cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxii (wrongly under J. F. JACQUIN).*

Part	Dates	Part	Dates
1	1764	3	1768
2	1767	4	1771

**Jacquin, N. J., *Miscellanea austriaca ad botanicam, etc.***  
*cf. B. G. SCHUBERT, Contr. Gray Herb. no 154 (1945) 3-5.*

Vol.	Dates
1	probably not issued before 1779
2	probably late 1781 or early 1782

**Jacquin, N. J., *Collectanea ad botanicam, etc.***  
*cf. B. G. SCHUBERT, Contr. Gray Herb. no 154 (1945) 3-5.*

Vol.	Probable Dates	Vol.	Probable Dates
1	1787	4	1791
2	1789	5	? late 1796
3	first half 1790	(suppl.)	

**Jacquin, N. J., *Icones plantarum rariorum*.**  
*cf. B. G. SCHUBERT, Contr. Gray Herb. no 154 (1945) 3-23.*

Vol.	Part	Dates	Vol.	Part	Dates
1	1	1781	1	4	1784
	2	1782		5	1787?
	3	1783		6	1787?

<i>Vol.</i>	<i>Part.</i>	<i>Dates</i>	<i>Vol.</i>	<i>Part.</i>	<i>Dates</i>
2&3	7	1787?	2&3	9	1792 or 1793
	8	1787?		10	
	Text-list I 1787?			11	
	1	1787		12	1794 or 1793
	2	1788		13	
	3	or 1789		14	
	4	1789		15	1795
	5	1789		16	1795
	6	1790		Text-list II 1795	
	7	1790		<i>Ditto</i> III 1795	
	8	1792			

**Note.** Plates were not issued in the order in which they are bound, but rather in fascicles of 25 each, as they happened to be completed! To ascertain the composition of the fascicles see SCHUBERT *l.c.* p. 10-23.

**Jaubert, H. F. & E. Spach, *Illustrationes plantarum orientalis, etc.***  
*cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 9 (1939) 255-259.*

Vol.	Part	Pages	Plates	Dates
1	1	i-vi, 1-24	1-10	Mar. 1842
	2	25-48	11-20	May 1842
	3-4	49-72	21-40	Oct. 1842
	5	73-96	41-50	Dec. 1842
	6	97-112	51-60	Mar. or Apr. 1843
	7	113-?130	61-70	Aug. 1843
	8	?131-?144	71-80	Oct. 1843
	9	?145-?160	81-90	Feb. 1844
	10	?161-168	91-100	Mar. 1844
	11	1-?16	101-109	July 1844
2	12	?17-?32	110-120	Nov. 1844
	13	?33-?40	(pl. 114, however, in 1845!)	Feb. or Mar. 1845
	14-16	?41-?80	131-160	Dec. 1845
	17-18	?81-96	161-180	July 1846
	19-20	90-end	181-200	Feb. 1847
	3	21-23 1-?40	201-230	Sept. 1847
	24-25	?41-?64	231-250	June or July 1848
	26	?65-?80	251-260	Nov. 1848
	27	?81-?96	261-270	Sept. 1849
	28	?97-?112	271-280	Dec. 1849
3	29	?113-?136	281-290	Apr. 1850
	30	?137-152	291-300	June 1850
	4	31 1-?16	301-310	Dec. 1850
	32	?17-?32	311-320	Apr. 1851
	33	?33-?48	321-330	June 1851
	34	?49-?64	331-340	Nov. 1851
	35	?65-?80	341-350	Apr. 1852
	36	?81-?96	351-360	Aug. 1852
	37	?97-?112	361-370	Nov. 1852
	38	?113-?120	371-380	Mar. 1853
4	39	?121-?136	381-390	June 1853
	40	?137-147	391-400	Oct. 1853



<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>	<i>Vol.</i>	<i>No</i>	<i>Pages</i>	<i>Dates of issue</i>
5	41	1-78	401-410	Dec. 1853		3	97-144	1 Nov. 1856
	42	79-224	411-420	May 1854		4	144-203	21 Mar. 1857
	43	225-232	421-430	June 1854	2	5	1-48	21 June 1857
	44	233-240	431-440	Nov. 1854	(1858)			
	45	241-256	441-450	May 1855		6	49-96	2 Nov. 1857
	46	257-264	451-460	June 1855		7	97-144	20 Feb. 1858
	47	265-280	461-470	Oct. 1855		8	145-205	20 May 1858
	48	281-288	471-480	June 1856	3	9	1-64	20 Aug. 1858
	49	289-2104	481-490	Aug. 1856	(1859)			
	50	2105-116	491-500	Feb. 1857		10	65-112	1 Nov. 1858
						11	113-160	1 Feb. 1859
						12	161-214	11 Apr. 1859
<b>Jepson, W. L., Manual of the flowering plants of California.</b>						13	1-48	1 July 1859
<i>cf.</i> L. C. WHEELER, Amer. J. Bot. 29 (1942) Suppl. 19-20.					4			
The work is claimed to have been issued in 6 fascicles on various dates during 1923 and 1925. The original fascicles were <i>not</i> found in U.S. libraries and the earliest notice that has been found announcing any part for sale was published in 1926.					(1860)	14	49-100	19 Sept. 1859
						15	101-156	8 Dec. 1859
					5	16	157-309	10 Feb. 1860
					(1861)	17	1-52	5 June 1860
						18	53-108	14 Nov. 1860
						19	109-156	27 Mar. 1861
<b>Jordan, A. &amp; P. J. Fourreau, Icones ad floram Europae, etc.</b>						20	157-200	24 May 1861
<i>cf.</i> F. PELLEGRIN, Bull. Soc. Bot. Fr. 84 (1937) 296-297; W. T. STEARN from dates given in the work itself and from contemporary reviews ( <i>in litt.</i> ).					6	21	1-48	1 Nov. 1861
					(1862)			
						22	49-96	1 Mar. 1862
						23	97-150	15 May 1862
						24	151-220	1 Nov. 1862
					7	25	1-56	4 Mar. 1863
					(1864)			
<i>Vol.</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>			26	57-110	13 May 1863
1	1-12	1-29?	Oct.-Dec. 1866			27	111-169	29 Oct. 1863
	13-48	30?-133?	Jan.-Nov. 1867			28	169-244	5 Apr. 1864
	49-66	134?-200	Jan.-Nov. 1868			29	245-254	3 Sept. 1864
2	1-16	201-253?	Jan.-Sept. 1869		Title, etc.	30	75-126, title & contents to vol. 7	30 June 1864
	17-24	254?-280	1871					
	25-50	281-354	June 1903		8	29	1-74	
					(1865)			
3	1-52	355-500	June 1903					
						31	127-210	12 Dec. 1864
						32	211-274	17 Feb. 1865
						33-34	275-279, title to vol. 8, pp. iv	12 June 1865
							1-128	
<b>Journal of the Asiatic Society of Bengal.</b>								
<i>cf.</i> C. D. SHERBORN, Index Animalium etc. sect. 2, 1 (1922) xxxv.					9			
Vol. 1-19, 1832-1851.					(1867)			
After vol. 1, each number was published in the following month, as the editor had to wait for the meteorological report. After Oct. 1838 the numbers appeared irregularly.						35	129-200	12 Oct. 1865
						36	201-263	14 Feb. 1866
						37	263-326	14 June 1866
						38	327-390	29 Nov. 1866
						39	391-454	6 Apr. 1866
						40	455-526, 527-530, title & contents	23 Aug. 1867
<b>Journal (of the Proceedings) of the Linnean Society of London. Botany.</b>								
<i>cf.</i> B. D. JACKSON, General Index to the first twenty volumes of the Journal (Botany) and the proceedings, Nov. 1838 to June 1886 of the Linnean Society. London 1888, p. v-vii.					10	41	1-64	5 Sept. 1867
					(1869)			
<i>Vol.</i>	<i>No</i>	<i>Pages</i>	<i>Dates of issue</i>			42	65-128	21 Feb. 1868
1	1	1-48	1 Mar. 1856			43	129-192	19 Mar. 1868
(1857)						44	193-256	14 May 1868
	2	49-96	1 June 1856			45	257-320	23 May 1868
						46	321-392	16 June 1868
						47	393-454	23 June 1868

<i>Vol.</i>	<i>No</i>	<i>Pages</i>	<i>Dates of issue</i>	<i>Vol.</i>	<i>No</i>	<i>Pages</i>	<i>Dates of issue</i>
	48	455-510	20 Jan. 1869		115-116	13-138	24 Dec. 1881
11 (1871)	49	1-64	9 Apr. 1869		117-119	139-200	13 Apr. 1882
	50-51	65-183	2 Aug. 1869		120	201-261	26 June 1882
	52	185-252	30 Dec. 1869		121	261-334	28 Aug. 1882
	53	253-348	10 May 1870		122	335-394	29 Nov. 1882
	54-55	349-468	17 Sept. 1870		123-124	1-24	18 Dec. 1882
	56	469-572	23 May 1871				
12 (1869)	issued complete	1-659	June 1869	20 (1884)	125	25-86	28 Feb. 1883
					126	87-158	24 Mar. 1883
13 (1873)	65	1-64	17 Aug. 1871		127	159-236	16 Apr. 1883
	66	65-144	5 Mar. 1872		128	237-312	6 June 1883
	67	145-203	29 May 1872		129	313-416	24 Sept. 1883
	68	203-266	4 Dec. 1872		130	417-464	26 Apr. 1884
	69	267-334	21 Mar. 1873		131	465-532	28 Apr. 1884
	70-72	335-582	20 June 1873				
14 (1875)	73	1-64	9 Oct. 1873				
	74	65-140	3 Dec. 1873				
	75	141-208	25 Apr. 1874				
	76	208-310	31 July 1874				
	77	311-390	17 Oct. 1874				
	78	391-483	1 Feb. 1875				
	79	483-546	24 Apr. 1875				
	80	547-641	5 July 1875				
15 (1877)	81	1-40	11 Oct. 1875				
	82	39-89 <sup>1/2</sup>	3 Mar. 1876				
	83	90-159	11 May 1876				
	84	159-252	11 July 1876				
	85	253-363	14 Sept. 1876				
	86	363-422	23 Oct. 1876				
	87	423-480	15 Dec. 1876				
	88	481-548	28 Feb. 1877				
16 (1878)	89	1-60	31 May 1877				
	90	61-140	14 July 1877				
	91	141-196	21 Aug. 1877				
	92	197-280	25 Sept. 1877				
	93	281-376	29 Nov. 1877				
	94	377-472	10 Jan. 1878				
	95	473-568	27 Feb. 1878				
	96-97	569-772	17 June 1878				
17 (1880)	98	1-86	31 July 1878				
	99	87-172	5 Nov. 1878				
	100	173-268	31 Dec. 1878				
	101	269-332	20 May 1879				
	102	333-404	20 Aug. 1879				
	103	405-510	1 Oct. 1879				
	104-105	511-607	30 Mar. 1880				
18 (1881)	106-107	1-122	3 Aug. 1880				
	108	123-194	15 Oct. 1880				
	109	195-263	31 Dec. 1880				
	110	263-367	21 Feb. 1880				
	111	367-419	29 Apr. 1881				
	112	419-472	3 June 1881				
	113	473-526	9 July 1881				
	—	527-551	30 Sept. 1881				
19 (1882)	114	1-13	30 Sept. 1881				

Note. A list of the dates of issue of the Proceedings of the sessions from 1855-86 can be found on p. vii of the above Index by JACKSON.

Jussieu, A. L., *Genera plantarum*.  
cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxi.  
Published in the 2nd half of 1789.

Kiaerskou, Hj. F. C. *Myrtaceae ex India Occidentali*  
(in Bot. Tidsskr. 17).  
cf. I. URBAN, Bot. Jahrb. 19 (1894) 563.

<i>Pages</i>	<i>Dates</i>
248-256 (in Heft 3)	30 Nov. 1889
257-292 (in Heft 4)	20 Aug. 1890

Note. Reprints of the complete paper were distributed April 1890!

König, C. & J. Sims, *Annals of Botany*, vol. 1-2.  
cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxii;  
J. BRITTEN, J. Bot. 40 (1902) 419 footnote.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	1-192	1 May 1804
	2	193-408	1 Sept. 1804
	3	409-592	1 Jan. 1805
2	1	1-208	1 June 1805
	2	209-392	1 Oct. 1805
	3	393-600	1 Sept. 1806

Korthals, P. W., *Kruidkunde* (in Temminck, Verh. Nat. Gesch. Ned. Overz. Bez., Botanicae).  
cf. H. C. D. DE WIT, Fl. Mal. Bull. no 6 (1950) 164-165.

<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1	1-28	1-10	5 Feb. 1840
2	29-60	11-17, 19-20	4 July 1840
3	61-92	18, 21-30	31 May 1841
4	93-124	31-40	18 Aug. 1841
5	125-156	41-46,	
		48, 50, 53, 58	17 Feb. 1842
6	157-196	47, 49, 51, 52,	22 Oct. 1842
		55, 56, 57, 59,	
		60, 64	
7	197-259	54, 61-63,	17 Feb. 1844
		65-70	

**Kraenzlin, F., *Orchidacearum genera et species.***  
*cf. A. B. RENDLE, J. Bot. 36 (1898) 451-452.*

Vol.	Part	Pages	Dates
1	1	1-64	10 July 1897 (Kew)
	2	65-128	15 Sept. 1897 (B.M.)
	3	129-192	9 Nov. 1897 (B.M.)
	4	193-256	14 Dec. 1897 (B.M.)
	5	257-320	19 Jan. 1898 (B.M.)
	6	321-384	12 Apr. 1898 (Kew)
	7	385-448	5 July 1898 (Kew)

(issued in  
error  
as 8)

(issued in  
error  
as 7)

8	449-512	20 June 1898 (Kew)
9	513-576	11 Oct. 1898 (B.M.)
10	577-640	15 Aug. 1899 (B.M.)
11	641-704	10 Oct. 1899 (B.M.)
12	705-768	2 Jan. 1900 (Kew); 23 Jan. 1900, B.M. Jan. 1900, Nat. Nov.)
13	769-832	27 Apr. 1900 (Kew)
14	833-896	27 Aug. 1900 (Kew)
15	897-960	6 Mar. 1901 (Kew)
16	961-986, i-viii	1 July 1901 (Kew)

Vol.	Part	Pages	Plates	Dates
2	1	1-32	1-4	17 Apr. 1903 (Kew)
	2	33-64	5-8	28 July 1903 (B.M.)
	3	65-96	9-12	17 Nov. 1903 (Kew)
	4	97-143	13-16	25 Mar. 1904 (Kew)

Note. This work was received in parts at the British Museum (Natural History) from the publishers, at Kew from the author, never on the same day but mostly within three weeks; the earliest of the two dates has accordingly been given above as approximating most to the date of issue in Germany; these dates are in general agreement with, but earlier than, announcements of publication in *Naturae Novitates* (W. T. STEARN, *in litt.*).

**Kunth, K. S.**

*cf. HUMBOLDT, BONPLAND, and KUNTH.*

**Kunth, K. S., *Mimoses et autres plantes légumineuses, etc.***

*cf. C. D. SHERBORN & B. B. WOODWARD, J. Bot. 39 (1901) 204.*

Published in 1 volume.

Part	Pages	Number of plates	Dates
1	1-4	5	June 1819
2	5-16	5	Sept. 1819
3	17-28	5	Dec. 1819
4	29-40	5	Apr. 1820
5	41-52	5	July 1820
6	53-72	5	Dec. 1820

Part	Pages	Number of plates	Dates
7	73-84	5	June 1821
8	85-96	5	Oct. 1821
9	97-108	5	Dec. 1821 or Jan. 1822
10	109-120	5	July 1822
11	121-140	3	July 1823
12	141-160	5	Jan. 1824
13	161-184	2	May 1824
14	185-223	2	June 1824

**Kunth, K. S., *Synopsis plantarum, etc.***

*cf. C. D. SHERBORN & B. B. WOODWARD, J. Bot. 39 (1901) 204.*

Vol.	Dates	Vol.	Dates
1	Dec. 1822	3	Feb. 1824
2	Apr. 1823	4	Jan. 1826

**Kunth, K. S., *Révision des Graminées, etc.* (in Humboldt, Bonpland & Kunth, *Nova genera et species plantarum*).**

*cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxi; C. D. SHERBORN & B. B. WOODWARD, J. Bot. 39 (1901) 205.*

Part	Pages	Number of plates	Dates
1	1-16	5	Feb. 1829
2	17-32	5	Apr. 1829
3	33-48	5	Apr. 1829
4	49-64	5	June 1829
5	65-80	5	June or early July 1829
6	81-96	5	Aug. 1829
7	97-120	5	Sept. 1829
8	121-136		
9	137-152	5	Nov. 1829
10	153-168	6	Dec. 1829
11	169-184	5	Jan. 1830
12	185-200	5	Feb. 1830
13	201-216	5	Mar. 1830
14	217-232	5	Mar. 1830
15	233-252	5	May 1830
16	253-272	5	June 1830
17	273-292	5	June 1830
18	293-308	5	July 1830
19	309-324	5	Aug. 1830
20	325-340	5	Aug. 1830
21	341-356	5	Nov. 1830
22	357-374	5	Dec. 1830
23	375-386	5	Dec. 1830
24	387-398	5	Feb. 1831
25	399-410	5	Feb. 1831
26	411-422	5	June 1831
27	423-434	5	June 1831
28	435-446	5	July 1831
29	447-458	5	Aug. 1831
30	459-474	5	Sept. 1831
31	475-486	5	Oct. 1831
32	487-498	5	Nov. 1831
33	499-510	5	Dec. 1831

Part	Pages	Number of plates	Dates
34	511-522	5	Dec. 1831
35	(counted as issued with 40)		
36	523-534	5	May 1832
37	535-546	5	May 1832
38	547-558	5	June 1832
39	559-570	5	June 1832
40	571-578	10	July 1832
41-44	579-end	21	Mar. 1834

Vol.	Part	Pages	Dates
4	1	1-400	Feb. 1797
			(KUNTZE: 1795-96)
	2	401-764	1798?
			(KUNTZE: 9 Feb. 1797
5	1-2	748 pp.	11 Jan. 1804
6	1-2		1806
7			1806
8			1808

Note. The same work was issued later as K. S. KUNTH, *Distribution méthodique de la famille des Graminées* (Paris 1835); plates and letter-press identical, but different paging.

**Kunth, K. S., *Enumeratio plantarum*.**

The following particulars, derived from HINRICHS, *Verz. und Allgemeine Bibliographie*, have been supplied by W. T. STEARN (*in litt*).

Vol.	Dates
1	July-Dec. 1833
Suppl.	Jan.-June 1835
2	Jan.-June 1837
3	July 1841 (see Note below)
4	July 1843
5	June 1850

Note. Although vol. 3 is listed in *Allgemeine Bibliographie für Deutschland* 6 (4 June 1841) 232, the publisher informed F. BUCHENAU that it was published in July 1841; *cf.* BUCHENAU in ENGLER, *Pflanzenreich* 4, 16 (*Butom.*) 6 (1903). KUNTH's name *Butomopsis* is thus antedated by *Tenagocharis* HOCHSTETTER in *Flora* (Regensb.) 24 (28 June 1841) 369.

**Labillardière, J. J. H. de**

*cf.* BILLARDIÈRE, J. J. H. DE LA.

**Lamarck, J. B. A. P. M. de, *Encyclopédie méthodique. Botanique*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxii; *ibid.* 3<sup>2</sup> (1898) 157; B. B. WOODWARD, *J. Bot.* 44 (1906) 318-320; W. ROTHMALER, *Chron. Bot.* 5 (1939) 438-440; B. L. BURTT, *Kew Bull.* (1951) 148.

Vol.	Part	Pages	Dates
1	1	1-368	Dec. 1783
	2	369-752	Aug. 1785
2	1	1-368	Oct. 1786
	2	369-774	Apr. 1788
			(ROTHMALER) or 1789
			(WOODWARD)
3	1 <sup>1</sup>	1-368	19 Oct. 1789
	2 <sup>2</sup>	369-703	1791-1792

**Lamarck, J. B. A. P. M. de (& Poiret), *Tableau encyclopédique, etc. Illustrations des genres*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxiii; *ibid.* 3<sup>2</sup> (1898) 156-157; W. ROTHMALER, *Chron. Bot.* 5 (1939) 438-440; H. A. GLEASON, *Phytologia* 2 (1947) 291-294.

Vol.	Part	Pages	Plates	Approximate date of issue
1	1	1-200	1-100 <sup>1</sup>	1791
				(wrapper)
	2	200-352	101-200	?1792 (before Feb. 1797)
	3	353-440	201-300	?1792 (before Feb. 1797)
	4	441-496	301-400	?1793
				(KUNTZE); after Feb. 1797 (others)
2	1	1-40	401-500	1793
				(wrapper)
	2	41-48	501-600	Nov. 1794
	3	49-72	601-700	1796 or 1797
	4	73-136	701-800	1797 or 1798
	5		801-900	1800
				(an VIII)
	6	137-552	901-950	1819
3	1	1-728	951-1000	15 Feb. 1823
		(incl. Suppl.)		

Note. As KUNTZE received a complete copy of 11 unbound parts from KLINCKSIECK in Paris, it is a pity that neither ROTHMALER nor GLEASON took his comment into consideration. Probably in this case the last word is not yet spoken.

**Lamarck, J. B. A. P. M. de (& A. P. De Candolle), (*La*) *Flore française*. ed. 2 and 3.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxii; F. N. WILLIAMS, *J. Bot.* 34 (1896) 431.

(1) Appeared later than GAERTNER's *De seminibus, etc.* vol. 1.

(2) Appeared later than GAERTNER vol. 2.

(1) The plates according to an announcement issued still in 1791!

Ed.	Vol.	Dates	Ed.	Vol.	Dates
2	1-3	1795 (An III)	3	1-4 5 (Suppl.)	1805 1815

Volume 4 is twice the size of the other volumes, and the 5 volumes of ed. 3 are mostly bound in six.

**Lambert, A. B.,** *A description of the genus Pinus, etc.*

cf. H. W. RENKEMA & J. ARDAGH, J. Linn. Soc. Lond. Bot. 48 (1930) 439-466; E. L. LITTLE JR, Madroño 10 (1949) 33-47.

Deal with the five editions published from 1803 to 1842. There is a great variation in contents among different copies of the same edition!

Edition	Vol.	Dates
1	folio	1 1803 (Appendix prob. 1807)
		2 1824
2	folio	1 1828
		2 1828
		3 1837 (completes both the 1st and 2nd edition)
3	octavo (editio minor)	1 1832
		2 1832
		Some copies of vol. 2 have 10 to 22 extra pages inserted between pages 144 and 145. By some authors called the second edition.
4	folio	1-3 1837-42 Essentially a reprint of the second edition.
5	octavo	1 1842
	folio	2 1842
		A re-issue of the 1832 edition with 30 extra pages between pages 144 and 145 and with the plates in a separate volume of larger size.

Note. For the names published on the extra pages see LITTLE's paper. RENKEMA & ARDAGH fully indexed the contents of the different editions.

**Ledebour, C. F. von, Flora altaica.**

cf. W. T. STEARN, J. Arn. Arb. 22 (1941) 228.

Vol.	Pages	Dates
1	xxiv+440	1829 (prob. 2nd half)
2	xvi+464	1830 (prob. 2nd half)
3	viii+368	1831 (prob. 2nd half)
4	xiv+336	1833 (prob. 2nd half)
Index	xcvi	1833 (thus dated, but prob. 1834)

**Ledebour, C. F. von, Icones plantarum novarum, etc.**

cf. W. T. STEARN, J. Arn. Arb. 22 (1941) 228.

Vol.	Part	Plates	Dates
1	1	1-50	1829
	2	51-100	1829

Vol.	Part	Plates	Dates
2	1	101-150	1830
	2	151-200	1830
3	1	201-250	1831
	2	251-300	1832
4	1	301-350	1833
	2	351-400	1833
5	1	401-450	1834
	2	451-500	1834

**Ledebour, C. F. von, Flora rossica.**

cf. W. T. STEARN, J. Arn. Arb. 22 (1941) 225-227.

Vol.	Part	Pages	Consp. pages	
1	1	iii-xvi, 1-240	1-8	1841 (late)
	2	241-480	9-16	1842 (prob. Oct.)
	3	481-790	17-22	1843 (prob. Mar.)
2	4	1-204		1843 (prob. Sept.)
	5	205-462		1844 (prob. July)
	6	463-718	1-13	1845 (prob. Aug.)
	7	719-937	II, 1-12	
			Fl. ross.	
			Fontes i-vi	1846 (prob. Aug.)
3 <sup>1</sup>	8	1-256		1847 (prob. Oct.)
	9	257-492	1-13	1849 (prob. June)
3 <sup>2</sup>	10	493-684	1-4	1850 (prob. Nov.)
	11	685-863	5-8	1851 (prob. Dec.)
4	12	1-240		1852 (prob. Apr.)
	13	241-464		1852 (prob. Sept.)
	14	465-741	1-16	1853 (prob. June)

**Lehmann, J. G. Ch., Pugillus plantarum** (Novarum et minus cognitarum stirpium pugillus 1-10... plantarum...).

cf. J. BRITTEN, J. Bot. 58 (1920) 198-200, 292-293.

The dates of issue for the 10 numbers are in accordance with PRITZEL's Thes. Lit. Bot.:

No	Dates	No	Dates	No	Dates
1	1828	5	1833	9	1851
2	1830	6	1834	10	1857
3	1831	7	1838	+index	
4	1832	8	1844		

Note. No 4 received by Linnean Society of London on 28 March 1832, no 6 received on 16 June 1834 (W. T. STEARN *in litt.*).

**Lehmann, J. G. Ch., Plantae Preissianae, etc.**

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 7 (1939) 203-205.

Vol.	Part	Pages	Probable dates
1	1	3-160	Sept. 1844
	2	& half-title 161-320	Dec. 1844 or Jan. 1845
	3	321-480	July 1845

Vol.	Part	Pages	Probable dates
	4	481-647, title, dedic., preface	Nov. 1845
2	1	3-160 & half-title	Oct. 1846
	2-3	161-499, title & prefaces	July 1848

**Lettson, J. C.,** *The natural history of the Tea-Tree, etc.*

cf. C. D. SHERBORN, *J. Soc. Bibl. Nat. Hist.* 1 (1938) 141.

In March 1772 received by the Gentlem. Magazine.

**L'Héritier de Brutelle, Ch. L.,** *Stirpes novae, etc.*  
cf. G. A. PRITZEL, *Thes. Lit. Bot.* (1872); O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxiii; *ibid.* 3<sup>2</sup> (1898) 157; J. BRITTEN & B. B. WOODWARD, *J. Bot.* 43 (1905) 267-268.

Part	Pages	Plates	Dates
1	i-vi, 1-20	i-x	Mar. 1785
2	vii-viii, 21-40	xi-xx	Apr. 1786
3	ix-x, 41-62	xxi-xxx	Apr. 1786
4	xi-xii, 63-102	xxxi-xlvi	Mar. 1788
5	xiii-xiv, 103-134	xlix-lxiv	Jan. 1789
6	xv-xvi, 135-181	lxv-lxxxiv	1789 (KUNTZE) or ?Dec. 1791

'Conspectus'

183-184

1791

Note. According to PRITZEL: in Geneva (Bibl. Candoll.) 28 tab. ineditae (fasc. 7 et 8); in Bibl. Morettiana 91 tab. ineditae, signed 1-84, 7, 30, 52, 53, 56, 57, 59bis. According to KUNTZE *l.c.* p. 157: in the Berlin Library (at present at Marburg) tab. 85-124 with printed names, but without text 'in exemplari beati Moretti Ticinensis'. According to KUNTZE the names are valid when they have priority, but it seems more probable that only those names are valid which had priority and were validly published by others, e.g. *Michauxia* L'HER. ex AITON and *Tricratus* L'HER. ex WILLD.

**L'Héritier de Brutelle, Ch. L.,** *Sertum anglicum, etc.*

cf. O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 157; J. BRITTEN & B. B. WOODWARD, *J. Bot.* 43 (1905) 272.

Part	Pages	Plates	Dates
1	36	i-ii	late 1788 or Jan. 1789
2		iii-xii	1790
3		xiii-xxiv	} 1792
4		xxv-xxxiv	

**Linden, J. & J. E. Planchon,** *Plantae columbianae.*  
cf. T. A. SPRAGUE, *Kew Bull.* (1926) 32-44.

Although the work was printed in 1863, according to URBAN it was never publicly issued. In about 1874-75 Prof. A. COGNIAUX, with J. LINDEN's permission, had five copies put together from the clean sheets, one for J. LINDEN, a second for the Botanic Garden, Brussels, and the remaining three for E. MARCHAL (Brussels), E. FOURNIER (Paris), and I. URBAN (Berlin) respectively. It is supposed that J. E. PLANCHON possessed proof sheets only. Kew acquired a copy in 1921 and it is in the Library of the Arnold Arboretum too. SPRAGUE's paper includes a commentary on the new species described by LINDEN & PLANCHON.

**Lindley, J.,** *Collectanea botanica, etc.*

cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxiii; B. B. WOODWARD, *Catalogue Books Brit. Mus.* (Nat. Hist.) 3 (1910) 1119.

In total 41 plates.

Part	Dates
1-2	before 1 Apr. 1821 (date of receipt Book Dept Brit. Mus.)
3	1 May 1821 ( <i>ditto</i> )
4-8	according to WOODWARD all issued in 1821, part 6 + prefatory matter dated 31 Oct. 1821. According to KUNTZE names from DON, <i>Prod. Flora Nepal.</i> (issued in 1825) were cited with pl. 37 and 41 (fasc. 8). So it seems sure that at least part 8 was <i>not</i> published before 1825.

**Lindley, J.,** *The genera and species of orchidaceous plants.*

According to footnotes, this was published as follows:

Pages	Dates
1-94	Apr.-June 1830
95-134	July-Aug. 1831
135-158	Dec. 1832
159-256	Jan.-May 1833
257-334	Aug.-Oct. 1835
335-366	Nov.-Dec. 1838
367-380	Jan. 1839
381-553, i-xvii	Jan.-Oct. 1840

**Lindley, J.,** *A sketch of the Swan River Colony* (in Appendix to the first twenty-three volumes of EDWARDS's Botanical Register).

cf. W. T. STEARN, *J. Soc. Bibl. Nat. Hist.* 2 (1952) 381-382.

Part	Appendix pages	Plates	Index	Dates
1	i-xvi	1-4	i-xxxii	1 Nov. 1839
2	xvii-xxxii	5-7	xxxiii-xlvi	1 Dec. 1839
3	xxxiii-lviii, explanation of plates	8-9	xlix-lxiv	1 Jan. 1840

**Lindley, J., *Folia orchidacea, etc.***

cf. B. B. WOODWARD, Catal. Books Brit. Mus.  
(Nat. Hist.) 3 (1910) 1121.

Part	Dates	Part	Dates
1	6 Nov. 1852	5	13 Feb. 1854
2	26 Jan. 1853	6 & 7	6 Nov. 1855
3	26 Feb. 1853	8	14 Mar. 1859
4	2 May 1853	9	31 May 1859

Note. The dates are those of receipt at the British Museum (Nat. Hist.).

**Link, H. F., *Enumeratio plantarum horti regii botanici Berolinensis altera.***

cf. W. T. STEARN, J. Bot. 75 (1937) 235.

Vol.	Date of issue	Vol.	Date of issue
1	1st half of 1821	2	1st half of 1822

**Link, H. F., *Hortus regius botanicus Berolinensis, descriptus.***

cf. W. T. STEARN, J. Bot. 75 (1937) 235.

Vol.	Date of issue	Vol.	Date of issue
1	2nd half of 1827	2	2nd half of 1833

**Link, H. F., F. Klotzsch & F. Otto, *Icones plantarum rariorum horti regii botanici Berolinensis.***

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 4 (1937) 106-107.

Vol.	Part	Pages	Plates	Dates
1	1	1-16	1-6	1840
	2	17-32	7-12	1840
	3	33-48	13-18	Dec. 1840 or Jan. 1841
2	4	49-62	19-24	1841
	1	63-78	25-30	1842
	2	79-94	31-36	1842
	3	95-110	37-42	1844
	4	111-123	43-48	1844

**Link, H. F. & F. Otto, *Icones plantarum selectarum horti regii botanici Berolinensis.***

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxiv;  
W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 4 (1937) 105-106.

Part	Pages	Plates	Dates
1	1-16	1-6	1820
2	17-32	7-12	Dec. 1820 or Jan. 1821
3	33-44	13-18	1821
4	45-56	19-24	late 1821 or early 1822
5	57-68	25-30	1822
6	69-80	31-36	1825
7	81-92	37-42	

Part	Pages	Plates	Dates
8	93-104	43-48	1826
9	105-116	49-54	1826 (possibly later)
10	117-128	55-60	Dec. 1828 or Jan. 1829

**Link, H. F. & F. Otto, *Icones plantarum rariorum horti regii botanici Berolinensis.***

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 4 (1937) 106.

Part	Pages	Plates	Dates
1	1-12	1-6	1828
2	13-24	7-12	1828
3	25-36	13-18	1828
4	37-48	19-24	1829
5	49-60	25-29	late 1829 or early 1830
6	61-72	30-36	1830
7-8	73-96	37-48	1831

**Linnaea.**

cf. I. URBAN, Bot. Jahrb. 19 (1894) 562;  
O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 158-159;  
H. K. SVENSON, Rhodora 41 (1939) 313.

Vol.	Part	Pages	Dates
1			1826
2			1827
3			1828
4			1829
5	1	1-176	Jan. 1830
	2	177-336	Apr. 1830
	3	337-496	July 1830
	4	497-688	Oct. 1830
	5	689-756;	?
		Liter. Ber. (1-214)	
6			1831
7			1832
8			1833
9			1834/5
10			1835/6
11			1837
12			1838
13			1839
14			1840
15			1841
16			1842
17			1843
18			1844
19	1	1-128	Jan. 1846
(1847)			
	2	129-256	Feb. 1846
	3	257-384	?
	4	385-512	Dec. 1846
	5	513-640	Feb. 1847
	6	641-765	Apr. 1847
20	1	1-128	May 1847
(1847)			
	2	129-256	June 1847
	3	257-384	July 1847
	4	385-512	Aug. 1847



<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
	5	513-640	Oct. 1847
	6	641-781	Dec. 1847
21			1848
22			1849
23			1850
24			1851
25	1	1-128	June 1852
(1852)	2	129-256	Dec. 1852
	3	257-384	Feb. 1853
	4	385-512	Apr. 1853
	5	513-640	June 1853
	6	641-end	Dec. 1853
26	1	1-128	Feb. 1854
(1853)	2	129-256	Apr. 1854
	3	257-384	Aug. 1854
	4	385-512	Feb. 1855
	5	513-640	May 1855
	6	641-807	Sept. 1855
27	1	1-128	Nov. 1855
	2-3	129-384	Jan. 1856
	4	385-512	Feb. 1856
28			1856/7
29	2	207-256	June 1858
	3	257-264	Sept. 1858
30	6	647-713	Mar. 1861
31			1861/2
33			1864/5
34			1865/6
35	5	513-612	Nov. 1868
			(early parts in 1867)
36	3	257-384	Jan. 1870
			(early parts in 1869)
	4	385-512	Apr. 1870
	6	2641-768	Dec. 1870
37		1-544	Feb. 1871
		545-647	Sept. 1873
38	3	257-384	May 1874
	4	385-512	July 1874
39		1-152	Feb. 1875
40	3	2257-384	Aug. 1876
	4	385-7512	Dec. 1876
41		145-192	Feb. 1877
		193-288	Apr. 1877
		289-356	Aug. 1877
42	1	1-112	1878 (by 8 Mar.)
	2	113-192	1878 (by 17 May)
	3	193-288	1879
	4	289-384	1879
	5	385-480	1879
	6-7	481-667	Nov. 1879
43	1	1-66	Sept. 1880
	2	67-138	July 1881
	3-4	139-252	Aug. 1881
	5-6	253-486	June 1882
	7	487-554,	July 1882
		i-xxiii	

Note. The dates on volumes 42-43 have been supplied by W. T. STEARN (*in litt.*).

**Linnaeus, C., *Amoenitates academicae*.**

*cf.* W. ROTHMALER, *Chron. Bot.* 5 (1939) 440.

Draws the attention to the fact that the 1st

edition was not taken into consideration for nomenclature; *e.g.* the '*Plantae Hybridæ*' are not inserted in the *Index Kewensis*. The promotion on that thesis was before 1753, but it appeared in the *Amoenitates* in 1756, and consequently the names have to be regarded as validly published.

**Linnaeus, C., *Mantissa plantarum prima*.**

*cf.* T. A. SPRAGUE, *Kew Bull.* (1929) 88-89.

It is assumed that this work appeared in November 1767, two months later than BERGIUS's *Descriptiones plantarum* (see there).

**Linnaeus, C., *Species plantarum ed. Willdenow*.**

See *sub* WILLDENOW.

**Martius, K. F. Ph. von, *Nova genera et species plantarum, etc.***

*cf.* B. B. WOODWARD, *J. Bot.* 46 (1908) 197-198.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1	1	1-20	1-12	1823
	2	21-36	13-24	1823
	3	37-80	25-55	1824
	4	81-158	56-100	1826
2	1	1-72	101-160	1826
	2	73-148	161-200	1827
3	1	1-80	201-231	1829
	2	81-136?	232-278?	1831
	3	137?-198	279?-300	1832

**Martius, K. F. Ph. von, *Historia naturalis Palmarum, etc.***

*cf.* B. B. WOODWARD, *J. Bot.* 46 (1908) 197.

<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1	1-(28?)	1-25	1823
2	(29?-60?)	26-49	1824
3	(61?-90)	50-67	1824
4	(91)-144	68-101	(1826)
		6a, 11a,	
		18a, 73a-c	
5	i-1ii	A-Q	1831
			(HEINSIUS: 1834) <sup>1</sup>
6	145-150	102-(133?)	1837
	153-180		
7	181-260	(134?-164)	1838 (or early 1839) <sup>1</sup>
8	liii-xcvi	R-Zvii,	1845
	261-304	Geol. ii,	
		iii,	
		165-170	15 Mar.
9	xcvii-clxiv	Zviii-xxiii,	
	305-314	171-180	
	315-350&		1850
	possibly also	1 portr.	
10	151-152		(HEINSIUS: 1853) <sup>1</sup>

(1) See *Flora* 22<sup>1</sup> (1839) 240 (this part of *Flora* being dated 21 April 1839); and HEINSIUS, *Allg. Bücherlexicon* 8 (1836) (for part 5); *ibid.* 9 (1846) (for part 7); *ibid.* 12 (1858) (for part 10).

Note. Part 7 was reprinted, as the paper on which it was issued originally proved inferior. The second edition of it appeared partly with part 8 (*viz* sheet 116–130), partly with part 9 (*viz* sheet 91–115). This 2nd edition of part 7 was emended by the author, as already mentioned in PRITZEL Thes. ed. 1. O. KUNTZE evidently misunderstood PRITZEL (*cf.* Rev. Gen. Pl. 1, 1891, cxxxvi, 725), and assumed there must exist a preliminary work of MARTIUS, with the title: *Genera et species Palmarum*. In fact nine out of the 10 parts were issued under that name, the tenth being entitled *Historia naturalis Palmarum*!

**Martius, K. F. Ph. von, *Amoenitates botanicae Monacenses, etc.***

*cf.* B. B. WOODWARD, J. Bot. 46 (1908) 198.

Part	Pages	Plates	Dates
1	1–8	i–v	1829
2	9–16	vi–x	1830
3	17–26	xi–xvi	1831
4			
		(not xiv)	

Note. Evidently the Latin title was used only on the wrappers of the parts; the complete work has a German and a French title-page. The letter-press is in three languages, including Latin.

**Martius, K. F. Ph. von, *Palmetum Orbignianum*** (in A. D'ORBIGNY, *Voyage dans l'Amérique méridionale*, vol. 7, 1847).

*cf.* C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 7 (1901) 388–389.

Date as on the title-page.

**Martius, K. F. Ph. von, *Genera et species Palmarum*** quas in itinere per Brasiliam a. 1817–1820 jussu et auspiciis Maximiliani Josephi I. Bavariae regis Augustissimi suscepto collegit, descripsit et iconibus illustravit. (*Editio nova*) Lipsiae (Weigel).

*cf.* HEINSIUS, Allg. Bücherlexicon 12 (1858); *ibid.* 13 (1863).

Part	Pages	Number of plates	Dates
1–2	1–58	49	1856
3–4	59–144	59	1857

Note. This new edition is unknown to me. It looks like being a reprint of Parts 1–4 of *Hist. nat. Palm.*—which were originally issued under a slightly different title, but were mostly referred to as '*Genera et species Palmarum*'—as pages and plates amount to the same number. As I have not seen it and did not find any data on it elsewhere, I do not know whether this edition was emended.

**Martyn, Th., *Thirty-eight plates with explanations, etc.***

*cf.* C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1 (1938) 142.

Received by the Gentlem. Magazine in Sept. 1788 (see Review on p. 818).

**Maund, B., *The Botanist.***

*cf.* J. BRITTEN, J. Bot. 56 (1918) 235–243 (incl. new species).

Vol.	No	Dates
1	1	Sept. 1836
		(although dated Jan. 1837)
	2	Nov. 1836
		(although dated Feb. 1837)
	3	Jan. 1837
		(although dated Mar. 1837)
	4	Mar. 1837
		(although dated Apr. 1837)
	5	May 1837
		(dated such)

The remaining numbers of vol. 1 and those of vol. 2–4 appeared about the first day of every month, up to Dec. 1840.

Vol.	Nos	Dates
5	1–8	Jan.–Aug. 1841 (two plates from the Jan. number, pl. 201, 203, appeared in Feb.)

Later numbers of this volume were delayed, and the Dec. number was issued later than spring 1842.

**Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg, sér. 6, *Sciences mathématiques, physiques et naturelles.***

*cf.* F. J. RUPRECHT, *Gedichte von Carl Bernhard TRINIUS* (1848) 32–36; P. L. RICKER, Proc. Biol. Soc. Wash. 21 (1908) 11–18.

The information below relates to pages containing botanical papers. RICKER gives particulars of the whole series.

Vol.	Part	Pages	Author	Dates
1	1	54–93	TRINIUS	Jan. 1830
	4	353–416	TRINIUS	Dec. 1830
	6	601–655	BONGARD	July 1831
2	2	119–177	BONGARD	Aug. 1832
	3	219–237	BONGARD	} Oct. 1832
		239–337	TRINIUS	
3.ii	1	69–83	} BONGARD	} June 1834
		85–87		
	2–3	89–346	TRINIUS	June 1834
		(reprint 1–267)		
	6	545–560	BONGARD	} Aug. 1835
		613–636	TRINIUS	
		(reprint 1–17)		} (Sept. 1835, Ruprecht)
4.ii	1	1–108	TRINIUS	Mar. 1836
	6	109–136	} BONGARD	} Mar. 1838
		137–142		
5.ii	3	1–8	} BONGARD	} Oct. 1839
		9–29		
		31–45		
		(reprint 1–15)		
		47–90	TRINIUS	} Oct. 1839
	4	91–165	RUPRECHT	
		167–189	TRINIUS	} Feb. 1840
		(reprint 1–23)		

<i>Vol. Part</i>	<i>Pages</i>	<i>Author</i>	<i>Dates</i>
6.ii 1-2	1-22	MEYER	} Nov. 1840
	23-134	TRINIUS	
	(reprint 1-112)		
	135-151	MEYER	
	153-156	FISCHER & MEYER	
3-4	157-246	BONGARD & MEYER	} June 1841
	247-390	TRINIUS	
	(reprint 1-144)		
7.ii 1-2	1-189	TRINIUS & RUPRECHT	Mar. 1843 (but separate earlier 1842)
3	191-223	MEYER	Mar. 1846
	225-298		
8.ii 3	1-39	MEYER	} Mar. 1849
	41-58		
	59-70	RUPRECHT	
	71-81		
9.ii	1-24	MEYER	} Nov. 1855
	25-54	RUPRECHT	
	55-82		

#### Memoirs of the Wernerian Natural History Society, Edinburgh.

*cf.* C. D. SHERBORN, *Index Animalium* 1801-50, (1922) p. xlvii; W. T. STEARN, *J. Bot.* 74 (1936) 322-323; A. A. BULLOCK in *Kew Bull.* (1953) 64-65; D. P. ROGERS in *Taxon* 2 (1953) 181-182.

The dates of the volumes and parts as determined by SHERBORN are given below. It appears, however, that certain papers may have been issued as separates ahead of their publication in the *Memoirs*; this is certainly true of G. DON, *Mon. Gen. Allium* (*cf.* STEARN, *l.c.*); a separate of D. DON's paper on *Melastomaceae* (*Mem. Wern. Soc.* 4, p. 276-329) was presented by him to the Linnean Society of London on 4 March 1823 (W. T. STEARN *in litt.*). See also under R. BROWN, On the *Asclepiadeae*, and G. DON, *Mon. of the genus Allium*.

Vol.	Pages	Dates
1		Oct. 1811
		(fide SHERBORN; but listed in <i>Edinb. Review</i> 18, p. 286 as published Feb.-May 1811)
2	1-260	May 1814
	261-700	1818
3		1821
4	1-252	May 1822
	253-603	May 1823
5	1-288	1824
		(rec. <i>Linn. Soc.</i> 14 June 1824 and rev. in <i>Phil. Mag.</i> 62, p. 449; 30 June 1824)
	289-599	1826
		(rec. <i>Linn. Soc.</i> 20 June 1826)
6		Jan. 1832
		(rec. <i>Linn. Soc.</i> 1 Feb. 1832)

Vol.	Pages	Dates
7		1838
8		after July 1839

Meyer, E. (H. F.), *Commentariorum de plantis Africae, etc.*

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxvi; H. S. MARSHALL, *J. Soc. Bibl. Nat. Hist.* 1, part 4 (1937) 102-103.

Vol.	Part	Pages	Dates
1	1	i-lvi,	14 Feb. 1836
		1-172	
	2	lvii-lxx,	1837
		173-326	

Note. The *Leguminosae* appeared later than those in ECKLON & ZEYHER's *Enumeratio*.

Michaux, A., *Flora boreali-americana*.

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxvi; *ibid.* 3<sup>2</sup> (1898) 159; B. G. SCHUBERT, *Rhodora* 44 (1942) 149.

MICHAUX's *Flora* has just precedence over vol. 3, part 3, of WILLDENOW, *Species plantarum* (see there). It was on sale in March 1803.

In PRITZEL *Thes. Lit. Bot.* 1872, this *Flora* is listed under L. C. M. RICHARD but how much of the work RICHARD wrote is uncertain; *cf.* MARIE-VICTORIN, *Contr. Lab. Bot. Montréal* 18 (1931) 8, 20.

Miller, J. F., (*Icones animalium et plantarum*), *etc.*

*cf.* J. BRITTEN, *J. Bot.* 51 (1913) 255-257.

Plates	Dates	Plates	Dates
1-12	1776	31	1781
13-18, 21	1777	32-34, 36	1782
19, 20, 22-24	1778	37-60	bear no dates, but evidently extend to 1794
25-28, 30	1779		
29	1780		

Miller, J. S., (*Icones novae*).

*cf.* J. BRITTEN, *J. Bot.* 51 (1913) 255-256; *ibid.* 57 (1919) 353; T. A. SPRAGUE, *J. Bot.* 74 (1936) 209.

Bound up with BANKS's copy of J. F. MILLER's (*Icones animalium et plantarum*) (see above) is a fascicle of 7 plates, to which BRITTEN could find no reference in any published work; they are dated 1780 and are accompanied by a descriptive text, of a character different from that of the *Ic. anim. plant.* BRITTEN at first expressed his doubt whether they were issued at all. Later evidence suggests that the work was actually published, as several copies are known.

It is sometimes cited as (*Icones plantarum*).

Miller, Ph., *Figures of . . . plants, etc.*

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxvi. According to PRITZEL dated 1760, but issued from 1755 onwards. Dates of issue are printed on every plate in accordance with the 1734 and 1766 British Copyright Acts.

Miquel, F. A. W., *c.s.*, *Plantae Junghuhnianae*.

*cf.* S. T. DUNN, J. Bot. 51 (1913) 358; WILT-SHEAR, F. G., J. Bot. 52 (1914) 44-45; C. G. G. J. VAN STEENIS, Fl. Mal. Bull. no 2 (1947) 50; H. S. MARSHALL, Kew Bull. (1953) 279-280.

Part	Pages	Dates
1	1-106	1851 (March)
2	107-270	1852
3	271-394	1854
4	395-522	1855
5	523-572	prob. 1856 (in any case before 1858)

Note. From all the original copies p. 571-572 are absent. The Leyden copy of VAN DEN BOSCH's reprint is completed with these pages.

Miquel, F. A. W., *Flora Indiae Batavae*.

*cf.* O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 159-160; C. G. G. J. VAN STEENIS, Bull. Jard. Bot. Btzig III, 13 (1934) 284-285, and Fl. Mal. Bull. no 2 (1947) 50; C. X. FURTADO, Chron. Bot. 5 (1939) 437-438.

Vol.	Part	Pages	Plates	Dates
1 <sup>1</sup>	1	1-160	1-2	1855
	2	161-336	3-4	1855
	3	337-512	5-7	1855
	4	513-688	8-9	1855
	5	689-864	10-11	Sept. 1856
	6	865-1116 +Index <i>etc.</i>	12-14	Aug. or Sept. 1858
1 <sup>2</sup>	1	1-176	15-18	25 Dec. 1858
	2	177-352	19-24	4 Aug. 1859
	3	353-512	25-29	6 Oct. 1859
	4	513-704	30	3 Nov. 1859
	2	1-176	31-32	4 Dec. 1856
	2	177-352	33-34	2 July 1857
	3	353-528	35	2 Aug. 1857
2	4	529-704	36	31 Dec. 1857
	5	705-880		Apr. 1858
	6	881-960		30 Sept. 1858
	7	961-1103		4 Aug. 1859
	3	1-176	37	end Oct. 1855
	2	177-352	38-40	25 Dec. 1856
	3	353-528		26 Nov. 1857
4	529-773	41	29 Dec. 1859	
		2 maps		

Miquel, F. A. W., *Flora Indiae Batavae. Supplementum I. Prodrum Flora sumatranae* (Sumatra, zijne plantenwereld, *etc.*).

*cf.* C. G. G. J. VAN STEENIS, Fl. Mal. Bull. no 10 (1953) 363.

Part	Pages	Plates	Dates
1	i-xx, 1-160	1-2	1860
2	161-336	3	1861
3	xxi-xxiv, 337-656	4	1861

Note. The dates were derived from an unbound copy in the original wrappers.

The German (Sumatra, seine Pflanzenwelt, *etc.*) edition was issued in 1862; only the title and the preface were translated in German.

Miquel, F. W. A., *c.s.*, *Annales Musei botanici Lugduno-Batavi*.

*cf.* T. NAKAI, J. Arn. Arb. 6 (1925) 211-213; Bot. Mag. Tokyo 40 (1926) 363-365; J. G. B. BEUMÉE, Fl. Mal. Bull. no 5 (1949) 137.

Vol.	Part	Pages	Dates
1	1	1-160	1863
	2	161-331	1864
2	1	1-160	1865
	2	161-313	1866
3		1-315	1867
4	1	1-96	1868 (BEUMÉE)
	2	97-320	1869 ( <i>ditto</i> )
	1	1-160	1868 (NAKAI)
	2	161-319	1869 ( <i>ditto</i> )

Note. For volume 4 the data derived by BEUMÉE from a copy in the original wrappers at the Agricultural College Library, Wageningen, differ slightly from those of NAKAI who ascertained his data from the wrappers of an unbound copy at the Royal Botanic Gardens, Edinburgh.

Miquel, F. A. W., *Illustrations de la flore de l'Archipel Indien*.

*cf.* C. G. G. J. VAN STEENIS, Fl. Mal. Bull. no 5 (1949) 137.

Part	Pages	Plates	Dates
1	1-48	1-13	1870
2	49-96	14-25	1870
3	i-x	26-37	1871
	(preface by SURINGAR), 97-114		

Note. Nothing is known of a 2nd edition as mentioned in the BRADLEY Bibliography.

Moricand, St., *Plantes nouvelles (ou rares) d'Amérique*.

*cf.* O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 160; A. REHDER, Bradley Bibliogr. 1 (1911) 329.

Plates	Dates	Plates	Dates	Plates	Dates
1-6	1833	27-38	1838	61-70	1841
7-16	1836	39-50	1839	71-84	1844
17-26	1837	51-60	1840	85-100	1846

Note. Originally partly published in Mém. Soc. Phys. Hist. Nat. Genève 6: 529-536; *ibid.* 7: 249-264; with 16 pl., 1833-36. Reissued 4 + 176 pp., 100 pl., Genève 1833-46.

Mouillefert, <i>Traité des arbres &amp; arbrisseaux forestiers, etc.</i>						Vol.	Ser.	Vol.	Part	Pages	Dates
cf. E. M. TUCKER, J. Arn. Arb. 3 (1922) 227-229.									4	267-462	1870
Issued in 38 parts, bound in 3 vols, 1891-1898.						6	2	1	1	1-2122	?1870
Dates of issue and pages of parts were given by the publisher to Mr A. REHDER; the list is copied in Miss TUCKER's cited paper.								(1874)	2	? (123)-2220	?1871
									3	2221-2279	?1872
									3	2221-2279	?1872
									3	2221-2279	?1873
Mühlenberg, H. L. & K. L. Willdenow, Ueber die Nordamerikanischen Weiden (paper no XIV in Ges. Naturf. Freunde Berlin Neue Schriften 4, 1803).						7	2	2	1	281-2451	1874
cf. M. L. FERNALD, Rhodora 48 (1946) 13-14.								(1877)	2	77-138	1876
Not issued prior to May 3, 1803, and probably not available until late in 1803 or early 1804.									3	139-278	1877
The paper is antedated by MICHAUX, Flora Bor.-Amer. in which 5 new species were described.						8	2	3	4	279-391	1877
								(1882)	1	1-162	1878
									2	163-268	1879
									3	269-398	1881
La Naturaleza, Mexico.									4	399-493	1882
cf. H. M. SMITH, Lloydia 5 (1942) 95-96.						9	2	4	1	1-138	1883
SMITH gives a complete enumeration of publication dates of the fascicles (entregas) of ser. 1, vol. 1-7, and ser. 2, vol. 1-3, published between 1869-1912. As the periodical seems of minor value for Flora Malesiana, the list is not copied here.								(1886)	2	139-202	1884
									3	203-354	1885
									4	355-562	1886
						10	2	5	1	1-102	1887
								(1891)	2	103-340	1888
Nederlandsch Kruidkundig Archief. Verslagen en Mededeelingen der Nederlandsche Botanische Vereeniging.									3	341-596	1889
cf. W. H. WACHTER, Ned. Kruidk. Arch. 43 (1933) 1-3.						11	2	6	4	597-693	1891
Additional data from wrappers of unbound copies at Leyden.								(1895)	1	1-168	1892
									2	169-278	1893
									3	279-514	1894
									4	515-760	1895
Vol.	Ser.	Vol.	Part	Pages	Dates	12	3	1	1	1-142	1896
								(1899)	2	143-291	1897
1	1	1	1	1-2115	1846				3	i-x,	1898
		(1848)	2	2117-299	1847				4	293-556	1899
			3	301-2368	1848				1	557-700	1900
			4	2369-563	1848	13	3	2	1	1-356	1900
2	1	2	1	1-136	1849			(1903)	2	357-548	1901
		(1851)	2	137-278	1850				3	549-846	1902
			3	1-143	1851				4	847-1076	1903
			4	145-288	1851				Suppl.	1077-1133	1904
3	1	3	1	1-2196	end						
		(1855)			1851	Vol.		Dated			Dates of issue
			2	2197-389	1853	14		(1904)			
					or 1854	15		(1905)			
			3	2391-2429	1855	16		(1906)			
			4	2431-522	1855	17		(1907)			
4	1	4	1	1-95	1856	18		(1908)			
		(1859)	2	97-160	1856	19		(1910), erroneously			
			3	161-338	1858			1909 on the back of			
			4	i-viii,	1859	20		the binding			
				341-516				(1911), erroneously			

<i>Vol.</i>	<i>Dated</i>	<i>Dates of issue</i>	<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates of issue</i>	
23	(1913)	early 1914	54				
24	(1914)	1915	55		Gedenkboek	May 1947	
25	(1915)	early 1916	(1945)		(Memorial volume)		
26	(1916)	early 1917	56			Jan. 1949	
27	(1917)	early 1918	57			6 May 1950	
28	(1918)	31 May 1919	58			1 May 1951	
29	(1919)	31 May 1920					
30	(1920)	15 July 1921	<b>Nicholson, G., Illustrated dictionary of gardening.</b>				
31	(1921)	30 Sept. 1922	Published in parts between 1884 and 1888. Dates				
32	(1922)	30 Sept. 1923	of issue are given in the work itself, vol. 4, pp.				
33	(1923)	30 Sept. 1924	249-250.				
34	(1924)	31 May 1925	<b>Nova Guinea. Résultats de l'expédition scientifique</b>				
35	(1925)	31 Aug. 1926	néerlandaise à la Nouvelle Guinée. Leiden, E. J.				
36	(1926)	30 June 1927	Brill. Editor of <b>botanical volumes</b> Dr A. A. Pulle.				
			cf. Prospectus bound up with vol. 18.				
<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates of issue</i>	<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
37	1	1-124	30 Apr. 1928	8	1	1-220	1909 (prob. Dec.)
(1927)					2	221-426	1910 (prob. Aug.)
	2	125-236	30 June 1928		3	427-611	1911 (prob. Nov.)
38	1	1-80	31 Oct. 1928		4	613-898	1912 (prob. Sept.)
(1928)					5	899-988	1913 (prob. Sept.)
	2	81-179	15 Feb. 1929		6	989-1048	1914 (prob. May)
39	1	1-144	30 June 1929	12	1	1-108	1913 (prob. May)
(1929)					2	109-172	1914 (prob. Apr.)
	2	145-404	15 July 1929		3	173-272	1915 (prob. Jan.)
	3	405-590	1 Mar. 1930		4	273-477	1916
40	1	1-128	1 July 1930		5	479-559	1917
(1930)				12 <sup>2</sup>	Atlas		1918
	2	129-192	1 Oct. 1930	12 <sup>3</sup>	Atlas		1918
	3	193-324	3 Dec. 1930	14	1	1-172	1924 (July)
41	1	1-177	1 July 1931		2	173-291	1926 (May)
(1931)					(1927)		
	2	178-448	31 Dec. 1931			292-336	1927 (May or
	3	449-593	4 Apr. 1932				June)
42	1	1-184	4 Apr. 1932		3	337-516	1929
(1932)			(as thesis		4	517-532	1929 (July)
			23 Nov. 1931)		(1932)		
	2	185-507	15 Nov. 1932			533-539	1930 (Mar.)
43			15 Dec. 1933			540-548	1930
(1933)						549-570	1932 (prob. Sept.)
44			31 Aug. 1934	18	1	1-8	1934 (May)
(1934)					(1935)		
45	1	1-157	31 July 1935			9-85	1934 (Nov.)
(1935)	2	161-304	5 Dec. 1935		2	89-126	1936 (Sept.)
46	1	1-295	June 1936	<i>New series:</i>			
(1936)				4		109-112	1940
	2	297-689	Oct. 1936			133-150	1940
	3	690-981	5 Dec. 1936				
47			Dec. 1937				
(1937)							
48			26 Nov. 1938				
(1938)							
49			Dec. 1939				
(1939)							
50			Dec. 1940				
(1940)							
51			Dec. 1941				
(1941)							
52			Dec. 1942				
(1942)							
53			Dec. 1943				
(1943)							

Note. As the printing, especially of the parts of vol. 14, took a long time, pre-issued reprints were distributed to the authors from 1926 onwards. These reprints are mostly provided with two dates on the wrapper, viz 'Publié . . .' in the middle of the wrapper, and another (mostly later) date at the bottom. It became evident that 'Publié' is an incorrect translation for 'printed'. The correct year of issue is found at the bottom. The issued parts are mostly dated later, e.g. vol. 14 pt 4 as a whole is dated and issued 1932, whereas the reprints were dated and distributed from 1929 onwards! Most of the dates could be ascer-

tained from letters with the publisher and authors etc. in the archives of the editor. Unfortunately the firm of Brill destroyed all, not recent, files.

**Nuttall, Th., The genera of North-American plants, etc.**

cf. O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 160.  
Was issued end of May 1818. Evidently later than W. BARTON's Comp. Flor. Philadelphicae. The latter cited NUTTALL with his consent from galley proofs. RAFINESQUE was acquainted with NUTTALL's names from BARTON's work and corrected some of them before they had been actually published!

**Nuttall, Th., Collections towards a Flora of the Territory of Arkansas** (in Trans. Amer. Philos. Soc. 5, 1834).

cf. R. C. FOSTER, Rhodora 46 (1944) 156-157.  
Vol. 5 of the Transactions is dated 1837, certainly incorrect for the cited paper. It is assumed that p. 139-184 at least had been issued by the end of 1835 (p. 139-160 by or soon after the middle of 1835), and that the remainder, p. 185-203, appeared in early 1836.

**Nuttall, Th., Descriptions of new species and genera of ... Compositae ...** (in Trans. Amer. Phil. Soc. ser. 2, vol. 7).

cf. GREENE, Erythea 3 (1895) 177-178.

Part	Pages	Dates
1	non botanical	1840
2	283-356	1840
3	357-453	1841

**Nyman, C. F., Conspectus florae europaeae.**

cf. W. T. STEARN, J. Bot. 76 (1938) 113.

Part	Pages	Dates
1	1-240	1878 (prob. Sept. or Oct.)
2	241-492	1879 (Oct.)
3	493-676	1881 (prob. July)
4	677-858	1882 (Oct.)

**Palisot de Beauvois, A. M. F. J., Flore d'Oware et de Benin en Afrique.**

cf. O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 154; J. H. BARNHART, Proc. Amer. Phil. Soc. 76 (1936) 914-920; H. S. MARSHALL, Kew Bull. (1951) 43-49.

Following notes are from a copy with all the original wrappers consulted by Mr MARSHALL. In some cases, however, the livraison dates are evidently untrustworthy as found by Dr BARNHART. The pages in each fascicle are not known with certainty, the approximate pages are copied from BARNHART.

Vol.	Part	Appr. pages	Plates	Year on wrapper	Year found by BARNHART
1	1	titles vii-xii, 1-8	1-6	1805	1805

Vol.	Part	Appr. pages	Plates	Year on wrapper	Year found by BARNHART
2	11	9-16	7-12	1805	1805
		17-32	13-18	1805	1805
		33-40	19-24	1805	1805
		41-48	25-30	1805	1805
		49-60	31-36	1805	1805?
		61-72	37-42	1806	1809
		73-80	43-48	1806	1809
		81-88	49-54	1806	1810?
		89-100	55-60	1806	1810?
		titles, 5-12	61-66	1808	1810?
		13-24	67-72	1810	1810
		25-32	73-78	1810	1811?
		33-44	79-84	1816	not later than 1817
		45-52	85-90	1816	not later than 1817
16	17	53-72	91-96	1818	1818
			97-102	1818	1818
			103-108	1819	1819
			109-114	1819	or 1820
				1819	or 1820
				1820	1821

**Pallas, P. S., Flora rossica, etc.**

cf. B. D. JACKSON, J. Bot. 38 (1900) 189; W. T. STEARN, J. Arn. Arb. 22 (1941) 229-230.

Vol.	Part	Pages	Plates	Dates
1	1	viii+80	1-8, 8B, 9-50	1784
	2	114 pp.	50 pl.	1788
		extra plates: 1-25		1831

**Peters, W., Naturwissenschaftliche Reise nach Mossambique, etc.**

cf. W. P. HIERN, J. Bot. 18 (1880) 264; O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxviii.

The date given on the title-page is 1862, but from the preface of the second part it is learnt that the first part really appeared at the close of the year 1861; the last part appeared in 1864.

**Poeppig, E. F., Collectio plantarum chilensium I-III, ed. G. KUNZE.**

cf. O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 160.  
Issued before May 1830.

**Poeppig, E. F. & S. L. Endlicher, Nova genera ac species plantarum, etc.**

According to W. T. STEARN (*in litt.*), who has supplied the following information derived mostly from notices in HINRICHS, Verzeichnis, the dates of issue of this work merit detailed investigation,



Vol.	Part (decades)	Pages	Plates	Dates
1	1	1-4	1-10	1835
	2-3	5-20	11-30	1835
	4-6	21-36?	31-60	1835 or '36
	7-10	37?-62	61-100	1836
2	1-2	1-12	101-120	1836
	3	13-16	121-130	1837
	4	17-20	131-140	1837
	5-6	21-40	141-160	1838
	7-8	41-60	161-180	1838
	9-10	61-74	181-200	1839
				(Jan.-Feb.)
3	1-2	1-16	201-220	1840 (July)
	3-4	17-32	221-240	1841 (Aug.)
	5-6	33-52	241-260	1843
	7-10	53-91, index	261-300	1845
				(Jan.-Feb.)

**Pohl, J. E., *Plantarum Brasiliae icones et descriptiones etc.***

The following information regarding the issue of this work, which merits further investigation, has been supplied by W. T. STEARN (*in litt.*).

Vol.	Part	Pages	Plates	Dates
1	1	1-36	1-25	1826 (Aug.)
	2	37-60	26-50	1827
	3	61-92	51-75	1827
	4	93-136, title, dedica- tion, preface, list of subscribers	76-100	1828
2	1	1-40	101-125	1828 or '29
	2	41-?	126-150?	1830
	3	?	151?-175?	1830 or '31
	4	?-153	176?-200	1833

**Presl, K. B., *Reliquiae Haenkeanae*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 160; W. T. STEARN, *J. Soc. Bibl. Nat. Hist.* 1, part 5 (1938) 153-154.

Vol.	Part	Pages	Plates	Dates
1	1	iii-xv, 1-84	1-12	1825
	2	85-148	13-25	1827
	3	149-206	26-36	1828
	4-5	207-355, general title-page	37-48	1830
2	1	1-56	49-60	1831
	2	57-152	61-72	1835

**Presl, K. B., *Symbolae botanicae*.**

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxxxviii.

Vol.	Part	Dates	
1	1	Oct. 1830	
	2-3	Sept. 1831	
	4	?	
	5	?1832	} Received in the library of the Kön. Bot. Gesell- schaft Regensburg be- tween Mar.-Dec. 1834.
	6-7	?1833	

**Presl, K. B., *Prodromus monographiae Lobelia-  
cearum* (Abh. Kön. Böhm. Ges. Wiss. ser. 4, vol. 4).**

*cf.* W. T. STEARN, *J. Soc. Bibl. Nat. Hist.* 3 (1954) 14.

Issued between July and Sept. 1836.

**Presl, K. B., *Botanische Bemerkungen* (in Abh. Kön. Böhm. Ges. Wiss. ser. 5, vol. 3).**

*cf.* W. T. STEARN, *J. Soc. Bibl. Nat. Hist.* 3 (1954) 15.

Reprint not available before first half of 1846; first published in *Abhandlungen* in second half of 1845. Paging should be taken from *Abhandlungen l.c.* To obtain the page numbers add 430 to page numbers of independently paged memoir.

**Presl, K. B., *Epimeliae botanicae* (in Abh. Kön. Böhm. Ges. Wiss. ser. 5, vol. 6).**

*cf.* HOOKER, *J. Bot.* 4 (1852) 286; J. H. BARNHART, *Bull. Torr. Bot. Club* 32 (1905) 590-591, footnote; W. T. STEARN in *J. Soc. Bibl. Nat. Hist.* 3 (1954) 15.

Although bearing the title-page date 1849, the original paper cover is dated 1851, and according to J. MÜLLER (MUELL.-ARG.) it was not published until 1852. According to STEARN, however, the *Abhandlungen* was published by 20 October 1851; it is probable that both *Abhandlungen* and independently paged memoir were issued about the same time late in 1851.

**Proceedings of the American Academy of Arts and Sciences.**

See *sub* ASA GRAY, *Contributions, etc.*

**Proceedings of the Linnean Society of London.**

*cf.* B. D. JACKSON, General Index to the first twenty volumes of the *Journal (Botany)* and the proceedings, Nov. 1838 to June 1886 of the Linnean Society. London 1888, p. v-vii.

Vol.	Number	Pages	Dates of issue
1 (1849)	1	1-8	9 Mar. 1839
	2	9-16	27 Apr. 1839
	3	17-32	16 May 1839
	4	33-40	5 Nov. 1839
	5	41-48	17 Dec. 1839
	6	49-56	3 Mar. 1840
	7	57-64	7 Apr. 1840
	8	65-72	10 Nov. 1840
	9	73-80	17 Dec. 1840
	10	81-88	6 Apr. 1841
	11	89-96	22 Apr. 1841
	12	97-112	12 June 1841
	13	113-120	18 Jan. 1842
	14	121-128	5 Apr. 1842
	15	129-152	14 Nov. 1842
	16	153-160	16 Feb. 1843
	17	161-168	23 May 1843
	18	169-176	9 Aug. 1843
	19	177-184	7 Feb. 1844
	20	185-196	May 1844
	21	197-212	Sept. 1844

Vol.	Number	Pages	Dates of issue	Vol.	Part	Pages	Dates of issue
	22	213-220	? 1844	4	1	1-116	16 June 1879
	23	221-228	Feb. 1845		2	117-244	6 Oct. 1879
	24-27	229-268	6 May 1845		3	245-387	1 Dec. 1879
	28	269-284	May 1846		4	387-492	May 1880
	29	285-304	Aug. 1846	5	1	1-105	Aug. 1880
	30	305-312	16 Feb. 1847		2	106-272	22 Nov. 1880
	31	313-320	30 Apr. 1847		3	272-458	Feb. 1881
	32	321-328	13 May 1847		4	459-652	20 May 1881
	33	329-340	9 Sept. 1847	6	1	1-170	July 1881
	34	341-364	2 May 1848		2	170-408	12 Sept. 1881
	35	365-380	14 July 1848		3	409-711	Dec. 1881
	36	381-388	2 Oct. 1848		4	712-872	20 Mar. 1882
	37	389-401,	15 May 1849	7	1	1-135	23 May 1882
		index, title etc.			2	135-304	Aug. 1882
	38-40	1-48	6 Nov. 1849		3	304-404	28 Oct. 1882
					4	405-684	Apr. 1883
2 (1855)	41	49-64	16 Apr. 1850	8	1	1-180	19 June 1883
	42	65-80	18 Oct. 1850		2	181-298	17 July 1883
	43	81-96	30 Oct. 1850		3	299-417	19 Oct. 1883
	44	97-112	15 Apr. 1851		4	419-583	21 Feb. 1884
	45-46	113-144	4 Nov. 1851	9	1	1-181	23 May 1884
	47	145-160	19 Apr. 1852		2	183-443	19 Aug. 1884
	48	161-176	23 July 1852		3	445-866	29 Nov. 1884
	49-50	177-200	28 Oct. 1852		4	867-1242	4 Mar. 1885
	51	201-220	23 June 1853	10	1	1-126	4 June 1885
	52-53	221-252	8 Nov. 1853		2	127-279	31 July 1885
	54	253-268	7 Feb. 1854		3	280-554	21 Dec. 1885
	55	269-284	2 May 1854		4	555-881	3 Apr. 1886
	56-57	285-316	19 Sept. 1854	2nd series:			
	58	317-332	7 Nov. 1854	1	1	1-238	25 May 1886
	59	333-348	6 Feb. 1855		2	239-578	23 Aug. 1886
	59†	333†-336†	27 Feb. 1855		3	579-975	17 Nov. 1886
	60	349-364	1 May 1855		4	976-1237	22 Feb. 1887
	61-63	365-412	5 Sept. 1855				
	64-65	413-436	19 Oct. 1855				
	66	437-448,	31 Oct. 1855				
		title, index					

# **Proceedings of the Linnean Society of New South Wales. 1875-1887.**

cf. J. J. FLETCHER, Proc. Linn. Soc. N.S.W. II, 10 (1895) 533-536.

Vol.	Part	Pages	Dates of issue
1	1	1-20	27 Apr. 1875
	1	1-96	* Feb. 1876
	2	97-168	July 1876
	3	169-282	* Feb. 1877
	4	283-419	* Mar. 1877
2	1	1-122	* July 1877
	2	123-217	* Jan. 1878
	3	218-288	* May 1878
	4	289-401	* June 1878
3	1	1-76	* Sept. 1878
	2	77-161	* Dec. 1878
	3	161-305	(no data)
	4	306-443	* May 1879

(\*) Dates of registration; probably some of these are really as much as one month or even longer behind time.

## **Pursh, F., *Flora Americae Septentrionalis*; etc.**

cf. J. H. BARNHART, *Torreya* 4 (1904) 132-136; M. L. FERNALD, *Rhodora* 40 (1938) 354; W. T. STEARN, *Rhodora* 45 (1943) 415-416, 511-512.

Both volumes appeared in Jan. 1814, between pl. 1613 (1 Jan.) and pl. 1614 (1 Feb.) of the Bot. Magazine. The date falls between the 26th and 27th vol. of REES's *Cyclopaedia*.

## **Putterlick, A., *Synopsis Pittosporarum*.**

According to W. T. STEARN (*in litt.*), much search has yielded no evidence that this was published before November 1839 (cf. Allg. Bibl. Deutschland 1839, 719; 29 Nov. 1839). Hence the names for *Pittosporum* published by A. CUNNINGHAM in Ann. Nat. Hist. 1, 4 (2 Oct. 1839) 106-111 can be retained as having priority over PUTTERLICK's.

## **Rafinesque, C. S., *New flora and botany of North America*, etc.**

cf. J. H. BARNHART, *Torreya* 7 (1907) 177-182.

Part	Dates	Part	Dates
1	Dec. 1836	3	1st quarter of 1838
2	2nd half of 1837	4	late in 1838

## **Rafinesque, C. S., *Flora telluriana*.**

cf. J. H. BARNHART, *Torreya* 7 (1907) 177-182.

<i>Part</i>	<i>Dates</i>	<i>Part</i>	<i>Dates</i>	<i>Vol. Sect. Part</i>	<i>Contents</i>	<i>Dates</i>
1	1st quarter 1837	3	Nov. or Dec. 1837	10 I 19	Cornea-Croisade	May 1807
2	1st quarter 1837	4	about middle of 1838	II 20	Croisade-Czycrassy	27 June 1808
				11 I 21	D-Deluge	24 Sept. 1808
				II 22	Deluge- Dissimilitude	28 Nov. 1808
<b>Redouté, P. J., Les Liliacées.</b>						
<i>cf.</i> B. B. WOODWARD, J. Bot. 43 (1905) 26-28;						
W. T. STEARN, <i>Herbertia</i> 11 (1946) 15-16.						
8 Volumes, published 1802-16. For the complete						
list of the approximate dates of issue of the 80						
parts, see WOODWARD's paper.						
<b>Redouté, P. J., Les roses.</b>						
<i>cf.</i> B. B. WOODWARD, J. Bot. 43 (1905) 28-29.						
Published in 3 volumes, 1st edition 1817-24;						
2nd ed. 1824-26; 3rd ed. 1828-30.						
For full data see the cited reference.						
<b>Redouté, P. J., Choix des plus belles fleurs, etc.</b>						
<i>cf.</i> B. B. WOODWARD, J. Bot. 43 (1905) 29-30.						
One volume in 36 parts, 1827-33. The exact						
contents of each part is unknown; extensive						
other particulars in the cited reference.						
<b>Rees, A., c.s., The Cyclopaedia.</b>						
<i>cf.</i> B. D. JACKSON, J. Bot. 15 (1877) 107-108;						
<i>ibid.</i> 18 (1880) 87-88; <i>ibid.</i> 34 (1896) 87-88;						
'An attempt to ascertain the actual dates of publi-						
cations of the various parts of REES's Cyclopaedia'						
(Pamphlet, 1895; revised reprint in J. Bot. 34,						
1896, 307-311).						
<i>Vol. Sect. Part</i>	<i>Contents</i>	<i>Dates</i>				
1 I 1	A-Agoge	2 Jan. 1802				
II 2	Agogliastro- Amaranthoides	2 May 1802				
2 I 3	Amaranthus- Antimony	2 Sept. 1802				
II 4	Antimony- Arteriotomy	2 May 1803				
3 I 5	Artery-Babel- mendeb	Aug. 1803				
II 6	Babenhausen- Battersea	1 Feb. 1804				
4 I 7	Battery-Point- Biörnstill	1 Aug. 1804				
II 8	Biot-Bookbinding	1 Feb. 1805				
5 I 9	Bookkeeping- Brunia	1 Sept. 1805				
II 10	Brunia-Calvart	2 Sept. 1805				
6 I 11	Calvary-Cape of Good Hope	17 Feb. 1806				
II 12	Cape of Good Hope-Castra	23 May 1806				
7 I 13	Castramentation- Chalk	30 Sept. 1806				
II 14	Chalk-Chronology	1 Jan. 1807				
8 I 15	Chronometer- Clavaria	Jan. 1807				
II 16	Clavaria-Colisseum	1 Aug. 1807				
9 I 17	Collision- Congregation	Dec. 1807				
II 18	Congregation- Corne	1 Mar. 1808				
12 I 23	Dissimulation- Dynamics	Mar. 1809				
II 24	Dynamics-Eloanx	June 1809				
13 I 25	Elocution-Equation	14 Aug. 1809				
II 26	Equation- Extremum	Dec. 1809				
14 I 27	Extrinsic-Fibro- cartilage	2 Oct. 1809				
II 28	Fibro-cartilage- Food	1 Feb. 1810				
15 I 29	Food-Froberger	23 June 1810				
II 30	Frobisher- Generation	8 Oct. 1810				
16 I 31	Generation-Gniewe	Dec. 1810				
II 32	Gnoien-Gretna- Green	25 Jan. 1811				
17 I 33	Gretry-Hatfield- Regis	?				
II 34	Hatfield-Regis- Hilbe	12 Apr. 1811				
18 I 35	Hibiscus-Huysum	1 May 1811				
II 36	Huzanka-Increment	1 Aug. 1811				
19 I 37	Increment-Josephus	1 Sept. 1811				
II 38	Josephus-Kilmes	Dec. 1811				
20 I 39	Kiln-Laurenberg	?				
II 40	Laurenberg-Lights	Mar. 1812				
21 I 41	Light-house- Longitude	?				
II 42	Longitude- Machinery	?				
22 I 43	Machinery- Manganese	12 Mar. 1812				
II 44	Manganese- Mattheson	Oct. 1812				
23 I 45	Matthew-Metals	Dec. 1812				
II 46	Metals-Monsoon	Apr. 1813				
24 I 47	Monster-Muscle	Mar. 1813				
II 48	Muscle-Newton	12 Feb. 1813				
25 I 49	Newtonian-Oleinae	?				
II 50	Oleinae-Ozunicze	?				
26 I 51	P-Passiflora	1 June? 1813				
II 52	Passiflora- Perturbation	Dec. 1813				
27 I 53	Pertussis-Picus	Mar. 1814				
II 54	Picus-Poetics	?				
28 I 55	Poetry-Peaching	?				
II 56	Peaching-Punjoor	1 May 1814				
29 I 57	Punishment-Ram	?				
II 58	Ram-Repton	Dec. 1814				
30 I 59	Republic-Rock	?				
II 60	Rock-Rzemien	1815				
31 I 61	S-Sarabanda	?				
II 62	Sarabanda-Scotium	Sept. 1815				
32 I 63	Scotland-Shammy	Mar. 1816				
II 64	Shammy-Sindy	Feb. 1816				
33 I 65	Sine-Sound	May 1816				
II 66	Sound-Starboard	July 1816				

Vol.	Sect.	Part	Contents	Dates
34	I	67	Starch-Stuart	Oct. 1816
	II	68	Stuart-Szydlow	Oct. 1816
35	I	69	T-Testudo	Feb. 1817
	II	70	Testudo-Toleration	May 1817
36	I	71	Tolerium-Tumours	Aug. 1817
	II	72	Tumours-Vermelho	24 Oct. 1817
37	I	73	Vermes-Union	23 Dec. 1817
	II	74	Union-Wateeco	?
38	I	75	Water-Whitby	Apr. 1818
	II	76	Whitby-Wren	31 July 1818
39	I	77	Wren-Zyto: Aam-Baldwin	Dec. 1818
	II	78	Baldwin-Zollikofer. Titles	Sept. 1819
	III	79	Titles, Preface, Plates	Aug. 1820

Part A	Plates to complete	Delivered with 21 I
B	Do	Do 25 II
C	Do	Do 29 I
D	Do	Do 31 I
E	Do	Do 39 I
F	Do	Do 39 III

**Reichenbach, H. G. L.,** *Iconographia botanica exotica, etc.*  
cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli.  
Cited by PRITZEL (Thes. Lit. Bot.) as published 1827–30. According to KUNTZE it must have been issued from 1824 onwards.

**Reichenbach, H. G. L.,** *Nomenclator.* 1841.  
cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli.  
This title, cited e.g. by PFEIFFER, is identical with no 7510 in PRITZEL's Thes. Lit. Bot. (1872): *Der Deutsche Botaniker*. Bd 1. Herbarienbuch.

**Reinwardt, C. G. C.,** *Nova plantarum indicarum genera* (Sylloge plantarum 2, p. 1–15).  
cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli;  
C. G. G. J. VAN STEENIS, Fl. Mal. Bull. no 4 (1948) 97–99.  
Pages 1–15 of the 2nd volume of the Sylloge may have appeared late in 1825, the latest possible date being Feb. 1826.

**Retzius, A. J.,** *Observationes.*  
cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli.

Vol.	Dates	Vol.	Dates	Vol.	Dates
1	1779	3	1784	5	1789
2	1781	4	1786	6	1791

**Richard, A.,** *Mémoire sur la famille des Rubiacées, etc.*  
cf. O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 161.  
Was published in vol. 5 of the Mém. Soc. Hist. Nat. Paris. This volume was printed in 1829–30, but not issued before 1834. The reprints of RICHARD's paper (separately paged) were published in Dec. 1830, later than DE CANDOLLE's Prodromus vol. 4 which included the *Rubiaceae*.

RICHARD sent proofs of his paper to DE CANDOLLE with permission to make use of them.

**Richard, A.,** Voyage de . . . l'Astrolabe . . . pendant . . . 1826–29, sous le commandement de M. J. DUMONT D'URVILLE, etc. Botanique—Part 1. Essai d'une flore de la Nouvelle-Zélande. Part 2. *Sertum Astrolabianum.*  
cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 8 (1901) 333.

Part	Date	Part	Date
1	5 May 1832	2	1834

**Richard, A.,** *Histoire physique, politique et naturelle de l'île de Cuba* par M. Ramon de la Sagra. Botanique. *Plantas vasculares.*  
cf. O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 162.  
Was published in 1845; it is earlier and more complete than the Spanish edition (cf. URBAN, Bot. Jahrb. 19, p. 563).

**Richard, A.,** *Tentamen florae abyssinicae etc.* (in Voyage en Abyssinie . . . pendant 1839–45 . . . etc. Troisième partie: Botanique vol. 4 & 5).  
cf. C. D. SHERBORN & B. B. WOODWARD, Ann. Mag. Nat. Hist. VII, 8 (1901) 162.

Part	Vol.	Pages	Dates
3	4	i–xi, 1–254 255–304 305–472	probably early 1847  late 1847 late 1847 or early 1848
	5		probably 1851.

Note. Atlas, 3 pp., 102 pl., was published without date.

**Richter, K. (and R. L. A. M. Gürke),** *Plantae europaeae; enumeratio.*  
cf. W. T. STEARN, J. Bot. 77 (1939) 89.

Vol.	Part	Pages	Dates
1		Published as a whole vol.	1890 (prob. Oct.)
2	1	i–vi, 1–160	1897 (July)
	2	161–320	1899 (Jan.)
	3	321–480	1903 (Dec.)

**Roemer, J. J.,** *Archiv für die Botanik.*  
cf. R. PICH-SERMOLLI, Webbia 8 (1952) 436–442.  
Vol. 2 part 1 issued after Easter 1800 but no later than the late summer.

**Roemer, J. J.,** *Collectanea ad omnem rem botanicam spectantia.*  
cf. W. P. HIERN, J. Bot. 38 (1900) 494.  
The title-page contains the date 1809, but the publication apparently extended over 3 years, 1807–1810.

**Roemer, J. J. & J. A. Schultes,** *Systema vegetabilium, etc.*  
cf. W. T. STEARN, in unpublished provisional survey (Apr. 1951).

Vol.	Dates	Vol.	Dates
1	1st half of 1817	5	late 1819 or early 1820
2	late 1817	6	late 1820
3	middle of 1818	7 pt 1	1829
4	1st half of 1819	pt 2	late 1830

Note. Vol. 7 was edited by J. A. & J. H. SCHULTES after ROEMER's death. For the Mantissa see SCHULTES & SCHULTES.

**Roscoe, W., Monandrian plants of the order Scitamineae, etc.**

Information mainly from W. ROSCOE's mostly unpublished correspondence with Sir James E. SMITH (now in the library of the Linnean Society of London), by W. T. STEARN.

Part	Dates
1	early 1824 (?Feb. or Mar.)
2	1824 (?July; after 7 June 1824)
3	1825 (before 3 Sept. 1825)
4	
5	late 1825
6	
7	1826 (apparently between 7 April and 22 July 1826)
8	
9	1826 (apparently between 7 Oct. and 14 Dec. 1826)
10	
11	1827 (before 12 Aug. 1827)
12	
13	1827 (between 23 Oct. 1827 and 8 Jan. 1828)
14	1828
15	1829 (after May 1829)

Note. According to W. T. STEARN (*in litt.*) each part will have contained about 8 unnumbered plates. The numbers assigned to them in the systematic list issued in the last part bear no relation to the sequence of publication. Plates 27, 28, 42 and 45 were included in parts 9 and 10; plate 98 appeared after April 1827, plates 65 and 66 after October 1827.

**Roth, A. W., Novae plantarum species praesertim Indiae Orientalis.**

cf. W. T. STEARN, in unpublished provisional survey (Apr. 1951).

Probably issued in first half of 1821.

**Roxburgh, W., Plants of the coast of Coromandel, etc.**

Vol.	Part	Pages	Plates	Dates
1	1	1-28	1-25	May 1795
	2	29-40	26-50	Nov. 1795
	3	41-56	51-75	Aug. 1796
	4	57-68	76-100	1798 (before Sept.)
2	1(5)	1-16	101-125	May 1799
	2(6)	17-28	126-150	May 1800
	3(7)	29-40	151-175	Apr. 1802
	4(8)	41-56	176-200	May 1805
3	1(9)	1-24?	201-225?	July 1811
	2(10)	25?-48?	226?-250?	May 1815
	3(11)	49?-72?	251?-275?	Feb. or
	4(12)	73?-98	276?-300	Mar. 1820

Note. The dates of publication have been obtained from the archives of the Hon. East India Company by W. T. STEARN and the contents of the parts 1-8 from copies seen by him in their original state; unfortunately no unbound copies of parts 9-12 have been available and their exact contents are uncertain though probably as stated above.

**Roxburgh, W., Hortus bengalensis, etc.**

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli; C. B. ROBINSON, Philip. J. Sc. C. Bot. 7 (1912) 411-419.

1814 is accepted as the date of publication, also for 'A catalogue of plants, etc.' consecutively paged after the 'Hortus Bengalensis' (although its title-page is dated 1813). It contains mostly *nomina nuda*, but several names were based on pre-Linnean descriptions by RUMPHIUS and RHEEDE VAN DRAAKESTEYN.

**Roxburgh, W., Flora indica. ed. Carey & Wallich.**

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli; W. T. STEARN, in unpublished provisional survey (Apr. 1951).

Editio 1820-1824 = ed. CAREY & WALLICH with the latter's corrections and additions which do not occur in the edition of 1832.

Vol.	Date	Vol.	Date
1	1820	2	1st half of 1824

**Roxburgh, W., Flora indica (Serampore). 2nd edition. ed. Carey.**

cf. W. T. STEARN, in unpublished provisional survey (Apr. 1951).

Vol.	Date	Vol.	(Fate)
1	1832	3	1832
	(before Apr.)		(after Sept.)
2	1832		

**Royle, J. F., Illustrations of the botany ... of the Himalayan mountains etc.**

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxli; T. A. SPRAGUE, Kew Bull. (1933) 378-390; W. T. STEARN, J. Arn. Arb. 24 (1943) 484-487.

Part	Pages	Plates	Dates
1	1-40	4, 11-18, 22	Sept. 1833
2	v-xii, 41-72	1, 19-21, 23-28	Mar. 1834
3	xiii-xx, 73-104	2, 5, 29, 31-35, 37, 38	June 1834
4	105-136	30, 39, 40, 42, 44-46, 64, 76 as 75 (Primula), 78	Sept. 1834
5	137-176	3, 41, 48-51, 57, 62, 63, 74	Jan. 1835
6	177-216	7, 36, 43, 55, 56, 58, 60, 61, 75 as 75a (Phlomis, Salvia), & frontispiece to vol. 1	Apr. 1835

Part	Pages	Plates	Dates
7	217-248	8, 9, 47, 52, 59, 65, 67-69, 71, 77	Aug. 1835
8	249-288	53, 54, 66, 70, 72, 73, 79 (63a), 80, 87, 88	Dec. 1835
9	289-336	10, 81, 82, 83 (Procris), 84-86, 90, 100 (83, Putranjiva)	May 1836
10	337-384	89, 91-96, 98 (84a), 99 (78a) & frontispiece to vol. 2	Feb. 1839
11	xxi-lxxx, 385-472	title-pages, dedications, preface, lists, etc., 6, 97	before July 1840

Note. Recently ROYLE's herbarium, the whereabouts of which had been unknown since the eighteenth century, was rediscovered in Liverpool when the Liverpool Museums received as a gift the whole of the contents of the museum of the Liverpool Chemists' Association (*cf.* *Icom News* 63, June 1953, 22). An account of this Royle Herbarium with a list of the extant types has been published by H. STANSFIELD in *North Western Naturalist* 24 (1953) 250-265; and another in *Pharmaceutical J.* 170, no 4657 (1953) 74-75, 78-79.

**Rydberg, P. A., *Flora of the Rocky Mountains etc.***  
*cf.* M. L. FERNALD, *Rhodora* 38 (1936) 329-331.

The first edition, though dated 1917, was not available before early in 1918. The copy at the Gray Herbarium was received on March 5, 1918.

The second edition, dated 1922, was not available until January 21, 1923.

**Sagra, Ramon de la**

*cf.* RICHARD, A.

**Saint-Hilaire, A. F. C. P. (called A. de), *Plantes usuelles des Brésiliens.***

*cf.* B. B. WOODWARD, *J. Bot.* 42 (1904) 86-87.

Part	Plates	Dates when appearance chronicled in Bibliogr. de la France
1	1-5	31 Jan. 1824
	+ text	
2	6-10	12 June 1824
	+ text	
3	11-15	14 Aug. 1824
	+ text	
4	16-20	6 Nov. 1824
	+ text	
5	21-25	8 Jan. 1825
	+ text	
6	26-30	30 Apr. 1825
	+ text	
7	31-35	25 June 1825
	+ text	
8	36-40	21 Dec. 1825
	+ text	
9	41-45	3 Mar. 1827
	+ text	

Part	Plates	Dates when appearance chronicled in Bibliogr. de la France
10	46-50	21 Apr. 1827
	+ text	
11	51-55	16 June 1827
	+ text	
12	56-60	15 Sept. 1827
	+ text	
13	61-65	5 Apr. 1828
	+ text	
14	66-70	9 Aug. 1828
	+ text	

Note. Part 1 was reprinted in 1827 (chronicled 5 Sept. in Bibliogr. France).

**Saint-Hilaire, A. F. C. P. (called A. de), *Histoire des plantes les plus remarquables du Brésil et du Paraguay; etc.***

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxliii. Was published in 1825, not in 1824.

**Salisbury, W., *Hortus Paddingtonensis etc.***

*cf.* C. D. SHERBORN, *J. Soc. Bibl. Nat. Hist.* 1 (1938) 142.

Dated 1797, but not received by the Gentlem. Magazine before Nov. 1799 (see Review on p. 964)!

**Salm-Reifferschied-Dyck, J. M. Fr. A. H. I. zu, *Monographia generum Aloes et Mesembryanthemi.***

*cf.* W. T. STEARN, *Cactus & Succ. J.*, G. Br. 7 (1938) 38-44, 66-85.

Part	Dates
1	Jan. 1836
2	1837 (prob. June)
3	1840 (between July & Oct.)
4	1842 (prob. Mar.)
5	1849 (prob. May or June)
6	1854 (prob. May)
7	1863 (prob. Aug.)

Note. Index to plates of *Aloë* with their dates of publication see STEARN *l.c.* p. 39-44; index to plates of *Mesembryanthemum etc.* see STEARN *l.c.* p. 68-85.

The contents of parts 1-6 are listed by C. MUELLER under *Aloës* in WALPERS, *Ann. Bot. Syst.* 6 (1861) 130-133 and under *Mesembryanthemum* in *ibid.* 5 (1858) 16-22.

**Santapau, H., *The Acanthaceae of Bombay* (Univ. Bomb. Bot. Mem. 2).**

*cf.* H. SANTAPAU in *J. Bomb. Nat. Hist. Soc.* 51 (1953) 349.

As stated by SANTAPAU, *l.c.*, this work 'bears the date 1951 on the cover but in point of fact the monograph was only published on April 1st, 1952'.

**Schmidel, C. Ch., *Icones plantarum etc.***

*cf.* O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxliii (erroneously under SCHMIDEL).

Issued from 1747-1776.

**Schneevoogt, G. V. & H. Schwegman, *Icones plantarum rariorum etc.***

cf. W. T. STEARN, J. Bot. 78 (1940) 66-74.

Only 1 volume completed (pls 1-36).

Part	Plates	Dates	Part	Plates	Dates
1	1-3	1792	9	25-27	1793
2	4-6	1792	10	28-30	1793
3	7-9	1792	11	31-33	1793
4	10-12	1792	12	34-36	1793
5	13-15	1792	13	37-39	1794
6	16-18	1792	14	40-42	1795
7	19-21	1792	15	43-45	1795
8	22-24	1793	16	46-48	1795
				(after 16 May)	

**Schrader, Journal für die Botanik.**

cf. R. PICHI-SERMOLLI, Webbia 8 (1952) 436-442.

Vol. 1 part 2 issued in late summer or in autumn of 1799.

**Schrank, F. v. P. v., *Plantae rariores horti academici Monacensis, etc.***

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 5 (1938) 151-152.

Vol.	Part	Plates	Dates
1	1	1-10	Michaelmas 1817
	2	11-20	1817
	3	21-30	} Easter 1819
	4	31-40	
	5	41-50	July-Nov. 1819
2	6	51-60	Easter 1820
	7	61-70	} Jan.-June 1821
	8	71-80	
	9	81-90	} Jan.-June 1822
	10	91-100	

**Schultes, J. A. (& J. H. Schultes), *Systema vegetabilium. Mantissa.***

cf. W. T. STEARN, in unpublished provisional survey (Apr. 1951).

Published in ROEMER & SCHULTES, Syst. Veget.:  
vol. 1, late 1822; in *ibid.*:  
vol. 2, 1824; and in *ibid.*:  
vol. 3, 2nd half of 1827

Note. According to O. KUNTZE (Rev. Gen. Pl. 32, 1898, 161-162) the Mantissa were published in 8 parts. He gives some indications which might be of use for a future consideration.

**Schultz, F. W. & C. Billot, *Archives de la Flore de France et d'Allemagne.***

cf. C. E. SALMON, J. Bot. 66 (1928) 107-113.

Not of interest for Flora Malesiana.

**Schumacher, H. C. F., *Beskrivelse af Guineiske Planter etc.* (in Kongl. Danske Vidensk. Selsk. Skrifter 3, 1828, and 4, 1829).**

cf. H. S. MARSHALL, Kew Bull. (1953) 280.

According to MARSHALL this paper was pub-

lished as a reprint in 1827, a year before it was published in the cited periodical.

Mr A. W. EXELL, however, informed us of the opinion of C. CHRISTENSEN who stated (*in litt.* 16.3.1936):—'It is highly improbable that the reprint was finished in 1827, and I am nearly sure that it was first finished in 1829. Further it may be noted that the earliest review of the paper seen dates from late in 1829.' CHRISTENSEN stated further that some copies might have been given by SCHUMACHER to his friends at an earlier date.

**Schumann, K. & C. Lauterbach, *Die Flora der deutschen Schutzgebiete in der Südsee.***

cf. J. Bot. 38 (1900) 500-501.

Though the title-page bears the date '1901', the book was received at the British Museum (Nat. Hist.), Department of Botany, on Nov. 17, 1900!

**Seemann, B., *The botany of the voyage of H.M.S. 'Herald'.***

cf. T. A. SPRAGUE, J. Bot. 59 (1921) 22-23.

Part	Pages	Plates	Dates
1	5-56	1-10 & map of W. Esquimaux-land	1852
2	57-80	13-20 & map of Panama	1852
3	81-120	21-30	1853
4	121-152 or 160	31-40	1854 (fide W. T. STEARN)
5	153 or 161-200	41-50	1854
6	201-253	51-60	1854
7 & 8	255-320	61-80	1856
9	321-360	81-90	1856
10	361 (not 261)-483	91-100 & cancel-leaves 253-254, 279-280, 345-346 and 4 others	1857

**Seemann, B., *The Journal of Botany, British and Foreign.***

Vol. 1, 1863, vol. 2, 1864, etc.

**Senckenbergische Naturforschende Gesellschaft in Frankfurt am Main, *Museum Senckenbergianum.***

cf. G. M. MATHEWS in Austral. Avian Record 4 (1920) 15; W. T. STEARN in J. Soc. Bibl. Nat. Hist. 1 (1938) 155.

Vol.	Part	Pages	Plates	Dates
1	1	1-96	1-5	1833 (prob. Oct.)
	2	97-188	6-9, 11	1834 (first half)
	3	189-294	10, 12-18	1834 (prob. Dec.)
2	1	1-116	1-6	1836 (Jan.-Febr.)



Vol.	Part	Pages	Plates	Dates	Cent. Part	Pages	Plates	Probable Dates
	2	117-190	7-11	1837 (first half)	I 1-2	5-28	1-10	1835
	3	191-310	12-17	1837 (second half)	3-4	29-?	11-20	1836 or 1837
3	1	1-90	1-5	1839 (prob. Dec.)	5	?	21-25	1837 or 1838
	2	91-196	6-12	1842 (second half)	6	?	26-30	1838 (by Oct.)
	3	197-318	13-17	1845 (prob. Dec.)	7-8	?-84?	31-40	1839 (prob. Mar.)
					9-10	85?-100	41-50	1839 (prob. Apr.)
					11-12	101-112?	51-60	1839 or 1840
					13	113-120	61-65	1839 or 1840
					14	121-128?	66-70	prob. 1840
					15-16	129?-148	71-80	1840 or 1841
					17-18	149-?	81-90	1841
					19-20	?-193	91-100	1841 (by June)
					II 1-3	1-28	101-115	1842 or 1843
					4-5	29-44	116-127	1844
					6-10	45-89	128-150	1870

Sessé, M. & J. M. Mociño, *Plantae Novae Hispaniae*.

cf. T. A. SPRAGUE, Kew Bull. (1926) 417-425.  
The first edition was published in instalments as appendices to 'La Naturaleza' (see there), the periodical of the 'Sociedad Mexicana de Historia Natural', in the years 1887-1890. A 2nd edition was published in 1893.

Sessé, M. & J. M. Mociño, *Flora mexicana*.

cf. I. URBAN, Symb. Antill. 4 (1911) 662-663;  
T. A. SPRAGUE, Kew Bull. (1926) 417-425.

The first edition was published in instalments as appendices to 'La Naturaleza' (see there), the periodical of the 'Sociedad Mexicana de Historia Natural'. The copy at Munich was provided with dates by RADLKOEFER as follows:

Pages	Dates
i-viii	title-page dated 1887
ix-4	1891
5-8	1892
9-48	1893
49-136	1894 (incl. <i>Myrtus conferta</i> )
137-184	1895 (from <i>Myrtus racemosa</i> onwards)
185-263	1896

Note. A differently paged second edition was published in 1894, thus from p. 125 onwards appearing before the corresponding part of the first edition (p. 137 onwards). So up to p. 136 the first edition has priority and from p. 125 onwards the second edition has priority.

Sibthorp, J. & J. E. Smith, *Florae graecae prodromus*.

Title-page of vol. 1 dated '1806', of vol. 2 '1813' but the whole work actually published in 4 parts as follows (fide W. T. STEARN *in litt.*):

Vol.	Part	Pages	Dates
1	1	i-xvi, 1-218	1806 (prob. Oct.-Nov.)
	2	219-442	1809 (May-Nov.)
2	1	1-210	1813
	2	211-422	1816

Siebold, Ph. Fr. von & J. G. Zuccarini, *Flora japonica etc.*

cf. E. M. TUCKER, J. Arn. Arb. 2 (1921) 237-239; T. NAKAI, Bot. Mag. Tokyo 40 (1926) 361-362; W. T. STEARN MSS *ined.*

Smith, J. E., *Plantarum icones etc.*

cf. C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1 (1938) 142.

Received by the Gentlem. Magazine in Sept. 1789 (see Review on p. 827).

Smith, J. E., *Icones pictae plantarum rariorum*.

A copy in the original dated wrappers yields the following information (W. T. STEARN *in litt.*):

Part	Plates	Dates
1	1-6	Oct. 1790
2	7-12	Feb. 1792
3	13-18	Nov. 1793

Smith, J. E., *Exotic botany, etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxliv.

Issued from the end of 1804 or early 1805 to January 1807.

Sprengel, K., *Caroli Linnaei Systema vegetabilium*.

cf. W. T. STEARN, in unpublished provisional survey (Apr. 1951).

Vol.	Part	Dates
1		late 1824
2		1825
3		1st half of 1826
4	1 & 2	1st half of 1827
Suppl.		2nd half of 1828

Steudel, E. G., *Nomenclator botanicus etc.* 2nd edition.

cf. O. KUNTZE, Rev. Gen. Pl. 3<sup>2</sup> (1898) 162;  
W. T. STEARN, Candollea 8 (1939) 4; Allgemeine Bibliogr. 1840-1841.

Vol.	Section	Pages	Probable Dates
1	1-2	1-256	Aug. 1840
	3	257-384	Sept. 1840
	4	385-512	Oct. 1840
	5-6	513-768	Nov. 1840
	7	769-852	Dec. 1840
2	8	1-48	Dec. 1840
	9	49-176	Dec. 1840-
			Mar. 1841
	10	177-432	Apr. 1841
	11	433-560	June 1841
	12-13	561-810	Sept. 1841

Steudel, E. G., *Synopsis plantarum glumacearum*.

cf. A. B. RENDLE, J. Bot. 37 (1899) 33-34.

Particulars supplied by W. T. STEARN (*in litt.*).

Part	Fasc.	Pages	Dates
(Gram.)	1	1-80	Jan. 1854
	2	81-160	Feb. 1854
	3	161-340	by 20 Apr. 1854
	4-5	241-400	by 27 July 1854
	6	401-475, i-vii	} prob. Jan. 1855
	2	7	
(Cyp.)		1-80	
	8-9	81-240	prob. Apr. 1855
	10	241-348	prob. Sept. 1855

Note. The 1st and 2nd fascicles (pp. 1-160) evidently antedate BUSE's work in MIQUEL, *Plantae Junghuhnianae*, fasc. 3.

St Hilaire, cf. SAINT-HILAIRE.

Swartz, O., *Nova genera et species plantarum, seu Prodrum . . . vegetabilium . . . in Indiam Occidentalem etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxliv.

JACQUIN Collect. II 1788 and L'HÉRITIER Sertum Angl. 1788 antedate this work according to SWARTZ himself.

Sweet, R., *Hortus suburbanus Londinensis: etc.*

cf. C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1 (1939) 197.

In Feb. 1827 received by the Gentlem. Magazine (see Review on p. 155).

Temminck, *Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche bezittingen. Botanie.*

See under KORTHALS, Kruidkunde.

Teysmann, J. E. & S. Binnendijk, *Catalogus van 's Lands Plantentuin te Buitenzorg. Inedita* 1854.

cf. C. G. G. J. VAN STEENIS, Fl. Mal. Bull. no 3 (1948) 70.

Evidently only 2 copies of the catalogue exist; the new species are not validly published.

Thunberg, C. P., *Prodrum plantarum capensium etc.*

cf. W. ROTHMALER, Chron. Bot. 5 (1939) 440.

Published in two parts; the first part (6 sheets) was published as early as 1794, the remaining part in 1800. According to ROTHMALER often wrongly quoted, but PRITZEL gives 1794-1800 too.

Thwaites, G. H. K., *Enumeratio plantarum zeylanicae.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxliv.

Part	Pages	Dates
1	1-80	1858
2	up to p. 160	1859
3	up to p. 240	1860
4	up to p. 320	1861
5	up to p. 483	1864

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie.

Vol. 1 is dated 1834, but at least the first part, p. 1-32, was published in Aug. 1833 (C. L. BLUME, *De novis quibusdam plantarum familiis expositio, etc.*), as is evident from a French translation of this paper in Arch. Sc. Nat.

Torrey, J. & A. Gray, *A flora of North America etc.*

cf. B. D. JACKSON, J. Bot. 31 (1893) 298; E. M. TUCKER, J. Arn. Arb. 2 (1921) 183-184.

Vol.	Part	Pages	Dates
1	1	1-184	July 1838
	2	185-360	Oct. 1838
	3	361-544	June 1840
	4	545-698, Index (711), Title, etc., i-xiv, Errata	June 1840
2	1	1-184	May 1841
	2	185-392	Apr. 1842
	3	393-504	Febr. 1843

Transactions of the American Philosophical Society, etc.

See sub NUTTALL, Arkansas Flora, and Descriptions of Compositae.

Transactions of the Horticultural Society of London.

The following information, supplied by W. T. STEARN, is based on copies in original wrappers, contemporary notices in Monthly Literary Advertiser, etc. and statements in the Council Minutes of the Horticultural Society of London.

Vol.	Part	Pages	Plates	Dates
1	1	1-70	1-2	1807 (Apr.-May)
	2	71-112	3-5	1808 (after 3 May)
	3	113-170	6-8	1809 (after 2 May)
	4	171-206	9-13	1810 (after 3 Apr.)
	5	207-238	—	1811 (after 2 Apr.)
	6	239-266	14-16	1812 (after 4 Feb.)
2	1	1-80	1-6	1813 (Fruit Room) (after 18 May)
	2	81-126	6	1814 (Verd. Grape) (after 5 Apr.)
			—9	
	3	127-170	10-11	1815 (after 4 Apr.)
	4	171-224	12-13	1816 (May?)
	5	225-306	14-21	1817 (Apr.?)
		App. 1-3		
	6	307-400	22-30	1817 (Nov.?)
	7	401-410	28	1818 (Dimocarpus) (Mar. or Apr.)
			28	
				(Alex. Apple)

Vol.	Part	Pages	Plates	Dates
3	1	1-114	1-3	1818 (before Aug.)
	2	115-248	3-7	1819 (19 Jan.)
	3	249-379	8-13	1819 (before Aug.)
	4	379-465	14-15	1820 (Jan. or Feb.)
		l-xxi, Index App. 19-27		
4	1	1-152	1-4	1820 (4 May)
	2	153-314	5-10	1821 (29 Jan.)
	3	315-438	11-17	1821 (16 May)
	4	439-573	18-22	1822 (5 Feb.)
		Suppl. (i-vi, contents, index, cancels of 435-438)		1822 (6 May)
5	1	1-174	1-3	1822 (6 Aug.)
	2	175-270	4-12	1823 (12 May)
	3	271-368	13-16	1823 (15 Oct.)
	4	369-504	17-20	1824 (1 June)
	5	505-560	17, 17	1825 (19 Jan.)
6	1	1-120	1	1825 (24 May)
	2	121-254	2	1825 (18 Aug.)
	3	255-402	3-5	1826 (18 May)
	4	403-538	6-9	1826 (20 Dec.)
	5	539-586	10	1827 (23 Feb.)
7	1	1-208	1-5	1827 (23 May)
	2	209-298	6-9	1828 (26 Apr.)
	3	299-434	10-12	1829 (May ?)
	4	433-590	13-15	1830 (6 July)
	5	title, index, etc.		1831 (5 Jan.)
2nd series:				
1	1	1-110	1-2	1831 (18 July)
	2	111-170	3-5	1832 (20 Mar.)
	3	170-246	6-9	1832 (7 Aug.)
	4	247-342	10-12	1833 (1 May)
	5	343-418	13-15	1834 (21 Jan.)
	6-7	419-481	16-18	1835 (Mar. or Apr.?)
2	1	1-72	1-3	1836
	2	73-128	4-6	1836
	3	129-187	7-8	1838 (Mar. or Apr.)
	4	188-316	9-10	1839 (15 Jan.)
	5	317-480	11-12	1841
	6	481-555	13-16	1842
3	1	1-128	1-2	1844
	2	129-261	3-5	1845
	3	263-268	i-iv	1848

Transactions of the Linnean Society, London.

Vol.	Part	Dates	Vol.	Part	Dates
1		1791	8		1807
2		1794	9		1808
3		1797	10	1	1810
4		1798		2	1811
5		1800	11	1	1813
6		1802		2	1815
7		1804	12	1	1817

Vol.	Part	Dates	Vol.	Part	Dates
	2	1819		4	1845
13	1	1821	20	1	1846
	2	1822		2	1847
14	1	1823		3	1851
	2	1824	21	1	1852
	3	1825		2	1853
15	1	1826		3	1854
	2	1827		4	1855
16	1	1829	22	1	1856
	2	1830		2	1857
	3	1833		3	1858
17	1	1834		4	1859
	2	1835	23	1	1860
	3	1836		2	1861
	4	1837		3	1862
18	1	1838	24	1	1863
	2	1839		2	1863
	3	1840		3	1864
	4	1841	25	1	1865
19	1	1842		2	1865
	2	1843		3	1866
	3	1844			

Transactions of the Royal Society, Edinburgh, 1788.  
cf. C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1  
(1938) 142.

Received by the Gentlem. Magazine in June  
1788.

Triana, J. J., *Nuevos jeneros i especies de plantas  
para la flora Neo-Granadina.*

cf. T. A. SPRAGUE, Kew Bull. (1934) 394.  
1854 may be accepted as the correct date of  
publication. This rare work contains descriptions  
of 13 new genera and 21 new species. These were  
incorporated in H. KARSTEN, *Plantae Columbia-  
nae II* (Linnaea 28, 387-462, probably issued in  
1857). The new genera and species are listed in  
Kew Bull. *l.c.* p. 395-396.

Vahl, M., *Enumeratio plantarum etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxliv.  
The preface to vol. 1 is dated 1804, but the title-  
page is dated 1805; vol. 2, 1806.

Vaillant, *Voyage de la Bonite.*

cf. GAUDICHAUD-BEAUPRÉ, CH.

Velloso, J. M., *Florae fluminensis, seu Descrip-  
tionum etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxlv.  
Genera 1-309 = Sabbato, were issued in 1825.  
The work was reprinted and appended in Archivos  
Mus. Nac. Rio de Janeiro 5 (1880-81).

Text 1825, published 10 years earlier than the  
Icones, has usually been neglected.

Velloso, J. M., *Florae fluminensis icones.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxlv.  
On the title-page 1827; in reality published in  
1835.

Ventenat, E. P., *Tableau du regne végétal etc.*

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxlv.  
Appeared in An VII = 1799.

**Ventenat, E. P., Description des plantes nouvelles etc.**

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1 (1939) 199–200.

Part	Plates	Dates
1	1–10	Sept. 1800
2	11–20	late 1800 or early 1801
3	21–30	(prob. Mar.) 1801
4	31–40	(prob. June) 1801
5	41–50	(prob. Sept.) 1801
6	51–60	(prob. Feb.) 1802
7	61–70	(prob. May) 1802
8	71–80	(prob. July) 1802
9	81–90	(prob. Sept.) 1802
10	91–100	(prob. Dec.) 1802

**Ventenat, E. P., Jardin de la Malmaison.**

cf. W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 7 (1939) 200–201.

Vol.	Part	Plates	Dates
1	1	1–6	(prob. Apr.) 1803
	2	7–12	(prob. June) 1803
	3	13–18	(prob. July) 1803
	4	19–24	(prob. Sept.) 1803
	5	25–30	(prob. Dec.) 1803
	6	31–36	(prob. Jan.) 1804
	7	37–42	(prob. Apr.) 1804
	8	43–48	
	9	49–54	(prob. June) 1804
	10	55–60	(prob. July) 1804
2	11	61–66	(prob. Aug.) 1804
	12	67–72	(prob. Sept.) 1804
	13	73–78	(prob. Oct.) 1804
	14	79–84	Dec. 1804 or Jan. 1805
	15	85–90	(prob. Feb.) 1805
	16	91–96	(prob. Mar.) 1805
	17	97–102	(prob. June) 1805
	18	103–108	(prob. July) 1805
	19	109–114	(prob. Aug.) 1805
	20	115–120	(prob. Dec.) 1805

**Ventenat, E. P., Choix des plantes, etc.**

cf. A. W. EXELL, J. Bot. 76 (1938) 181–183;  
W. T. STEARN, J. Soc. Bibl. Nat. Hist. 1, part 7 (1939) 201.

Part	Plates	Probable dates	Part	Plates	Probable dates
1	1–6	1803	6	31–36	1808
2	7–12	1803	7	37–42	1808
3	13–18	1803	8	43–48	1808
4	19–24	1803	9	49–54	1808
5	25–30	1803	10	55–60	1808

**Voss, A., Vilmorin's Blumengärtnerei etc. 3rd edition.**

cf. E. M. TUCKER, J. Arn. Arb. 3 (1922) 229–230.  
The work was evidently published in 50 parts, one every two weeks.

**Vol. Pages Dates**

1	1–832	1894	2	1–244	doubtless completed in 1896
	833–1264	1895			

**Vriese, W. H. de, Plantae Indiae Batavae Orientalis etc.**

cf. H. C. D. DE WIT, Fl. Mal. Bull. no 6 (1950) 167–168.

Part	Pages	Dates	Part	Pages	Dates
1	1–80	14 Nov. 1856	2	81–160	3 Oct. 1857

**Waldstein, F. P. A. von & P. Kitaibel, Descriptiones et icones plantarum rariorum Hungariae.**

This work was issued in parts. According to an investigation made by W. T. STEARN in 1939 but not published, the dates of publication of the plates appear to be as follows:

Vol.	Plates	Dates
1	1–10	Nov. 1799
	11–30	1800
	31–50	1800 or 1801
	51–70	1801 (before July 1801)
	71–90	1801 or 1802
2	91–100	1802
	101–130	1802 or 1803 (before July 1803)
	131–160	1803 or 1804 (before July 1804)
	161–170	1803 or 1804
	171–190	1804
3	191–200	1805
	201–220	1806 or 1807 (before July 1807)
	221–240	1807
	241–250	1808 or 1809
	251–260	1809
	261–270	1810 or 1811
	271–280	1812

**Wallich, N., Tentamen florum nepalensis illustratae etc.**

cf. E. M. TUCKER, J. Arn. Arb. 18 (1937) 260.  
A list of 'Lithographic Publications . . . published at the Asiatic Lithographic Company's Press', dated 1 Aug. 1826, mentions the 2nd part of WALLICH's Tentamen as being still in the press (W. T. STEARN in litt., Feb. 1951).

Part	Pages	Plates	Dates
1	1–24	1–25	after June 1824
2	25–64	26–50	after Aug. 1826

**Wallich, N., Plantae asiaticae rariores, etc.**

cf. C. D. SHERBORN, J. Soc. Bibl. Nat. Hist. 1 (1939) 197; W. T. STEARN, in unpublished provisional survey (Apr. 1951).

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Plates</i>	<i>Dates</i>
1	1	1-22	1-25	1829 (prob. Sept.)
	2	23-42	26-50	1830 (prob. 6 Apr.)
	3	43-68	51-75	1830 (prob. 15 July)
	4	69-84, title, preface, etc.	76-100	1830 (prob. 1 Nov.) (prob. Sept.)
2	5	1-?	101-125	1830 (prob. 20 Dec.)
	6	?	126-150	1831 (prob. 4 Apr.)
	7	?-52	151-175	1831 (prob. 7 June)
	8	53-86, title, etc.	176-200	1831 (prob. 6 Sept.)
3	9	1-?	201-225	1831 (prob. 10 Dec.)
	10	?-28	226-250	1832 (prob. 20 Mar.)
	11	29-?	251-275	1832 (prob. 15 June)
	12	?-117	276-300	1832 (prob. 15 Aug.)

Note. Volume 1 is usually quoted as 1830. There is, however, conclusive evidence from several independent sources that the first part was published late in 1829. The above-mentioned information has been supplied by W. T. STEARN (*in litt.* Nov. 1953) and is based on library accession records of the Linnean and Horticultural Societies of London and contemporary notices in Gentleman's Mag., Oken's Isis, Hinrichs' Verzeichnis, Loudon's Gard. Mag., Literaturber. Allg. Bot Zeit. The parts certainly became available on the dates given above and were either issued in that month or a little earlier.

Wallich, N., *A numerical list etc.* (mostly cited 'Catalogue').  
cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) cxlv.

<i>Nos</i>	<i>Dates</i>
Foreword	1 Dec. 1828
1-2153	1829
2154-2603	1830
2604-4877	1831
4878-6224	betw. 1831-32
6225-7683	1832
Suppl. 7684-9149,	1847-49 viz:
after no 8234	22 Oct. 1847
after no 8622	5 Aug. 1848
p. 300	10 Nov. 1849

Webb, Ph. B. & S. Berthelot, *Histoire naturelle des îles Canaries*. Vol. 3. *Botanique*.  
cf. W. T. STEARN, *J. Soc. Bibl. Nat. Hist.* 1, part 2 (1937) 55-58.

As the list given by STEARN is very long, giving dates of issue of every single plate (more than 250 in total), and as this flora is only of little importance for Malaysia, it is not copied here. The dates of publication of the text take less space, but as in several cases the first valid publication is on the plates rather than in the text, it makes little sense to reprint text details only.

Weddell, H. A., *Chloris andina*. *Essai d'une flore etc.* (in F. de Castelnau, *Expédition dans l'Amérique du Sud*. Partie 6).  
cf. C. D. SHERBORN & B. B. WOODWARD, *Ann. Mag. Nat. Hist.* VII, 8 (1901) 164.

<i>Vol.</i>	<i>Part</i>	<i>Pages</i>	<i>Dates</i>
1	1	1-24	16 July 1855
	2	25-56	3 Dec. 1855
	3	57-136	30 June 1856
	4-6	137-184	15 Dec. 1856
	7	185-232	30 Nov. 1857
	8	1-16	1 Feb. 1858
	9	17-72	7 Mar. 1859
	10-11	73-112	10 Oct. 1859
	12-13	113-192	12 Nov. 1860
	14	193-224	Apr. 1861
	15	225-272	Oct. 1861
	16	273-316	Nov. 1861

Weddell, H. A., *Monographie des Urticacées*.  
cf. C. B. ROBINSON, *Philip. J. Sc. C. Bot.* 5 (1911) 471-473.

As BLUME in the 2nd volume of his *Museum Botanicum Lugduno-Batavum* deals with Urticaceae, dates of publication are very important for nomenclature. The decision is reached to accept that the first 400 pp. of WEDDELL's Monograph appeared in 1856 between fasc. 12 and 13 of vol. 2 of BLUME *Mus. Bot. Lugd.-Bat.*, while fasc. 13-16 preceded the remainder of the Monograph which probably did not appear before 1857.

Wendland, J. C., *Ericarum icones etc.*  
cf. O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) 964.  
Issued in fascicles of 6 plates between 1798-1823.

<i>Part</i>	<i>Dates</i>	<i>Part</i>	<i>Dates</i>
1-2	1798	15-16	1805
3-5	1799	17	1806
6-10	1800	18	1807
11	1802	19-21	1809
12	1803	22-24	1810
13-14	without date (1804)	25-27	1823
			(sec. PRITZEL)

Wendland, J. C., *Collectio plantarum etc.*  
cf. B. D. JACKSON, *Bull. Herb. Boiss.* 1 (1893) 297-298; O. KUNTZE, *Rev. Gen. Pl.* 3<sup>2</sup> (1898) 162.

Vol.	Part	Pages	Plates	Dates
1	1	1-27	1-6	1805
	2	29-44	7-12	1805
	3	45-59	13-18	1806
	4	60-72	19-24	1806
	5	73-84	25-30	1807
	6	85-98	31-36	1807
2	1	1-15	37-42	1810
			(or 1808) <sup>1</sup>	
	2	16-34	43-48	1810
	3	35-46	49-54	1809
	4	47-58	55-60	1809
	5	59-70	61-66	1810
	6	71-82	67-72	1810
3	1	1-12	73-78	1811
	2	13-28	79-84	1819

No title-  
page to  
the Kew  
copy

Title-page  
dated 1810

Volume not  
completed

Vol.	No	Plates	Dates
	3	1404-1501	Apr. 1849
	4	1502-1621	May 1850
5	1	1622-1762	May 1851
	2	1763-1920	Jan. 1852
6		1921-2101	Mar. 1853

Note. According to MERRILL the first twenty plates (vol. 1, no 1) are numbered between 35 and 723, the figures applying to the numbers of species as described in WIGHT & ARNOTT's *Prodromus*. In subsequent numbers fractional forms were used both on the plates and in the published explanations. The numerator represents the sequence of plate number for the 'Icones', the denominator is the species number in WIGHT & ARNOTT *l.c.*

**Wight, R., Catalogue of Indian plants.**

cf. H. S. MARSHALL, Kew Bull. (1953) 280.

Pages	Dates	Pages	Dates
1-64	28 May 1833	113-128	Apr. 1836
65-112	24 Sept. 1834	129-144	25 Sept. 1837

**Wight, R., Contributions to Indian botany.**

No 1 published in Madras J. Lit. Sc. 5 no 14 (dated 'January 1837'); reprint received by Linnean Society of London on 17 Aug. 1837.

No 2, published in Madras J. Lit. Sc. 5 no 15 (dated 'April 1837'); reprint received by Linnean Society of London on 2 Oct. 1837 (W. T. STEARN *in litt.*).

**Wight, R., Icones plantarum Indiae orientalis.**

cf. E. D. MERRILL, J. Arn. Arb. 22 (1941) 222-224.

Vol.	No	Plates	Dates
1	1	1-20	(July?) 1838
	2-3	21-60	Sept. 1838
	4-5	61-100	Nov. 1838
	6-8	101-161	June 1839
	9	162-181	Aug. 1839
	10	182-201	Sept. 1839
	11-12	202-241	Nov. 1839
	13-14	242-279	Feb. 1840
	15-16	280-318	May 1840
	<i>Part</i>		
2	1	319-416	1840
	2	417-514	1840-43
			(prob. 1841)
	3	515-631	1840-43
			(prob. 1842)
	4	632-736	1843
3	1	737-815	(May?) 1844
	2	816-930	1844-45
	3	931-1046	Nov. 1845
	4	1047-1162	Sept. 1846
4	1	1163-1282	Jan. 1848
	2	1283-1403	Aug. 1848

**Wight, R. & G. A. Walker-Arnott, Prodromus florum peninsulae Indiae orientalis.**

Vol. 1 all published; announced in LOUDON, Mag. Nat. Hist. 1 (Sept. 1834) as 'ready in a few weeks', recorded as a new publication in BENT'S Monthly Literary Advert. no 354 (10 Oct. 1834); hence early October 1834 can be accepted as date of publication (W. T. STEARN *in litt.*).

**Willdenow, C. L., Species plantarum (= LINNAEUS, Species plantarum ed. WILLDENOW).**

cf. O. KUNTZE, Rev. Gen. Pl. 1 (1891) cxxxiv; *ibid.* 3<sup>2</sup> (1898) 159; Intern. Rules of Nomencl. ed. 3 (1935) 12, 39, 68; B. G. SCHUBERT, Rhodora 44 (1942) 147-150.

Vol.	Part	Dates
1	1	before 4 Nov. 1797
	2	1798
2	1	1799
	2	before Feb. 1800
3	1	1800 (up to p. 850)
	2	before 10 Nov. 1802
		(up to p. 1470)
	3	14 Mar. 1803 still in press
		(up to p. 2409)
4	1	1805
	2	1806
5	1	1810
(Crypt.)		
	2	1830

Note. MICHAUX's Fl. Bor.-Amer. has precedence over WILLDENOW Spec. Plant. 3<sup>3</sup>, not over 3<sup>2</sup>.

**Willdenow, C. L., Hortus Berolinensis etc.**

cf. W. T. STEARN, J. Bot. 75 (1937) 233-235.

Vol.	Part	Plates	Dates
1	1	1-12	1803 (July-Nov.)
	2	13-24	1804 (Jan.-Feb.)
	3	25-36	1804 (Jan.-June)
	4	37-48	1805 (Jan.-June)
	5	49-60	1805 (July-Oct.)
	6	61-72,	1806 (Jan.-June)
		Preface,	
		Plan A	

(1) According to KUNTZE.

Vol.	Part	Plates	Dates
2	7	73-84	1806 (Juli-Sept.)
	8	85-96	1809 (by June)
	9	97-108	1812 (Jan.-June)
	10	Plan B	1816 (Jan.-June)
+ Epilogue			

Willdenow, C. L., *Enumeratio plantarum horti regii botanici Berolinensis, etc.*

cf. W. T. STEARN, J. Bot. 75 (1937) 234-235.  
2 Volumes published in the first half of 1809. A 'Supplementum post mortem auctoris editum' was published by D. F. L. VON SCHLECHTENDAL in the second half of 1814.

Willkomm, H. M., *Icones et descriptiones plantarum novarum . . . Hispaniae.*

cf. F. G. WILTSHEAR, J. Bot. 53 (1915) 370.

Vol.	Part	Pages	Plates	Dates
1	1	1-16	1-7	1852
	2	17-24	8-13	1853
	3	25-32	14-20	1853
	4	33-40	21-28	1853
	5	41-48	29-35	1854
	6	49-56	36-41	1854
	7	57-64	42-46	1854
	8	65-80	47-53	1854
	9	81-104	54-63	1855
	10	105-123	64-73	1856
2	11	1-24	74-83	1857
	12	25-40	84-93	1858
	13	41-56	94-101	1858
	14	57-68	102-109	1859
	15	69-84	110-118	1859
	16	85-96	119-128	1859
	17	97-108	129-138	1861
	18	109-120	139-148	1861
	19	121-182	149-158	1862

Willkomm, H. M. & J. Lange, *Prodromus florum hispanicae, etc.*

cf. F. G. WILTSHEAR, J. Bot. 53 (1915) 371.

Vol.	Part	Pages	Dates
1	1	i-viii, 1-192	1861
	2	ix-xxx, 193-316	1862
	3	317-480	1865
2	1	1-272	1865
	2	273-480	1868
	3	481-680	1870
3	1	1-240	1874
	2	241-512	1877
	3	513-736	1878
	4	737-1144	1880
Suppl.	i-ix, 1-370		1893

Willkomm, H. M., *Illustrationes florum Hispaniae Insularumque Balearium; etc.*

cf. F. G. WILTSHEAR, J. Bot. 53 (1915) 372.

Vol.	Part	Pages	Plates	Dates
1	1	1-12	1-9	1881
	2	13-28	10-18	1881
	3	29-40	19-28	1881
	4	41-56	29-38	1882
	5	57-72	39-47	1882
	6	73-88	48-56	1882
	7	89-104	57-65	1883
	8	105-120	66-74	1883
	9	121-136	75-83	1884
	10	i-vii, 137-157	84-92	1885
2	11	1-16	93-101	1886
	12	17-32	102-110	1886
	13	33-48	111-119	1887
	14	49-64	120-127	1888
	15	65-84	128-137	1889
	16	85-98	138-146	1889
	17	99-112	147-155	1890
	18	113-126	156-164	1891
	19	127-140	165-173	1892
	20	i-vii, 141-156	174-183	1892

Willmott, E. A., *The genus Rosa.*  
cf. E. M. TUCKER, J. Arn. Arb. 3 (1922) 230-231.

The book was published in 25 parts from 1910-1914. Full information on the dates of issue was printed on the back cover of the last part. The list is recorded in Miss TUCKER's cited paper. Though hardly of interest for Flora Malesiana, the book contains several descriptions of new species, especially of Chinese roses, by J. G. BAKER.

Wing's Southern Science Record.

cf. C. G. G. J. VAN STEENIS, Fl. Mal. Bull. no 7 (1950) 195.

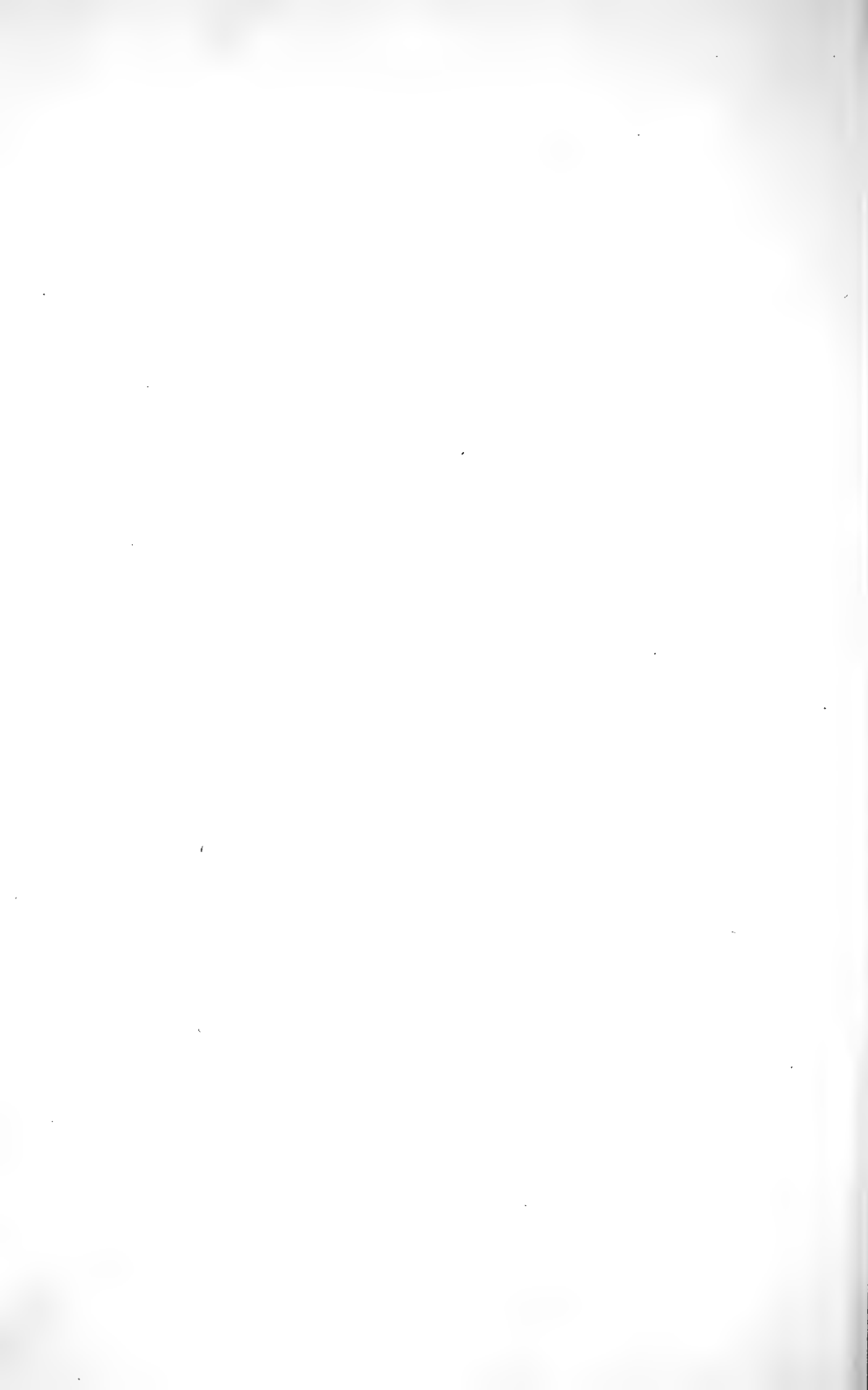
Vol.	Nos	Pages	Dates
1	1-13	1-216	1880-1881
	2	1-12	1882
	3	1-12	1-280 1883
New series:			
1	1-3		Jan.-May 1885
	1		Jan. 1886

Note. The Record contains several small contributions by F. VON MUELLER.





# TAXONOMIC REVISIONS



# ACERACEAE<sup>1</sup> (S. Bloembergen, Buitenzorg)

## 1. ACER

LINNÉ, Sp.Pl. (1753) 1054; PAX, Pfl.R. 8 (1901) 1; K. & V. Bijdr. 9 (1903) 252.

Trees or shrubs, buds with many perules. *Leaves* decussate, petiolate, entire, palmate or pinnate, appearing simultaneously with the flowers or later, exstipulate. Inflorescence racemose, corymbose or spicate, terminal with 2–4 leaves, or rarely terminal or axillary without leaves. Monoecious or dioecious, *flowers* actinomorphic, ♂ and ♀, ovary in the ♂ fls more reduced than stamens in ♀ fls. Calyx and corolla 4–5-merous. Stamens 4–10, mostly 8, hypogynous or perigynous. Disc extra- or intrastaminal. Ovary superior, 2-celled, laterally flattened, each cell with 2 ovules. *Fruit* a samara, splitting into 2, rarely 3, winged usually 1-seeded parts. Seed without endosperm, radicle elongate, cotyledons foliaceous, or thickened, plicate, involute or flat.

Distr. *Ca* 200 spp. in the N. hemisphere, only in Malaysia crossing the equator.

Notes. By BLUME, BENTHAM & HOOKER, MIQUEL, &c. this genus was included in the *Sapindaceae*. In Malaysia only one species.

1. *Acer niveum* BL. Rumphia 3 (1847) 193; PAX, Bot. Jahrb. 6 (1885) 293; *ibid.* 7 (1886) 207, *cum var. cassiaefolium*; WESMAEL, Bull. Soc. Bot. Belg. 29 (1890) 41, *cum var. praec.*; SCHWERIN, Gartenfl. 42 (1893) 228, *cum var. laurinum & praec.*; PAX, in E. & P. 3, 5 (1896) 267, 271; Pfl.R. 8 (1901) 4, 31; K. & V. Bijdr. 9 (1903) 254; BACKER, Schoolfl. (1911) 272; HEYNE, Nutt. Pl. (1927) 987; KOORD. Fl. Tjib. 2 (1923) 153; MERR. En. Philip. 2 (1923) 493; STEEN. Bull. J.B.B. III, 13 (1936) 148.—*A. javanicum* (non BURM. f., 1768) JUNGH. Monatsber. Berl. Geogr. Ges. 1842; JUNGH. & DE VR. Tijd. Nat. Gesch. & Phys. 10 (1843) 138.—*A. laurinum* HASSK. *ib. nomen*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 582, Suppl. (1860) 200, 511; BOERL. Handl. 1 (1890) 281.—*Laurus alba* BL. Rumphia 3 (1847) 193, *in syn.*—*A. cassiaefolium* BL. *l.c.*—*A. philippinum* MERR. Gov. Lab. Publ. 35 (1906) 36.—*A. curranii* MERR. Philip. J. Sc. 4 (1909) Bot. 285.—**Fig. 1.**

Tree up to 48 m, clear bole up to 28 m by 70 cm, buttresses to 2 m high. At the start of the dry season foliate twigs sprout 2–4 together simultaneously from last year's buds; inflor. appearing in the axils of fallen leaves. Both flower and shoot-buds *ca* 4 mm long with 4–9 pairs of decussate *ca* 2 mm long caducous perules. *Leaves* simple entire glabrous, glossy dark green above, glaucous, whitish or light blue-grey below; petiole 1<sup>1</sup>/<sub>4</sub>–10 cm; blade elliptic to lanceolate, 3- to slightly 5-plinervous at the base, apex acuminate to tailed, tip subacute. Inflor. corymbose, either ♂ or ♀, rarely with few fls of the other sex, glabrous, 2<sup>1</sup>/<sub>2</sub>–10 (in fruit to 19) cm long; peduncle 1<sup>1</sup>/<sub>2</sub>–3<sup>1</sup>/<sub>2</sub> cm, pedicels 4–17 mm. *Flowers* pale yellowish. Sepals and petals (3–)5, free, resp. 2<sup>1</sup>/<sub>2</sub>–3 and 1<sup>1</sup>/<sub>2</sub>–2<sup>1</sup>/<sub>2</sub> mm long. Stamens (4–)6(–8) in 1 whorl, sometimes isomerous and then alternating with the petals, attached on the disc in pits; filament in ♂ 5 mm, in ♀ 2.2 mm; anther

3/4 mm (in ♀ slightly smaller and not dehiscent). Disc flat, glabrous to woolly. Ovary 2 mm broad, densely woolly, in ♂ (with the styles) usually

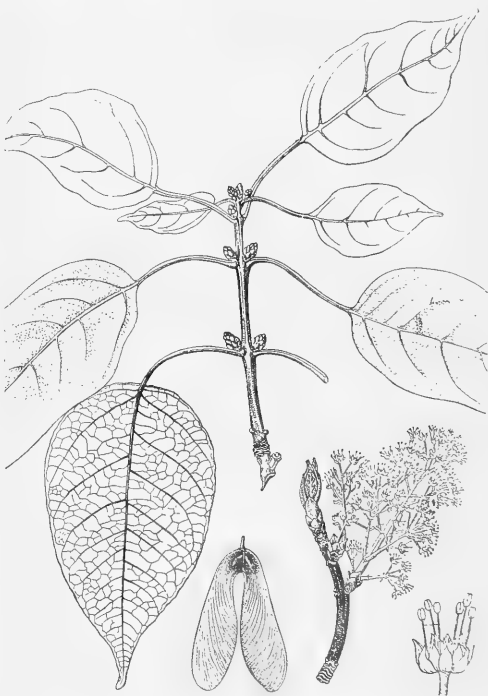


Fig. 1. *Acer niveum* BL.  $\times \frac{1}{3}$ , flower enlarged.

strongly reduced. Styles 2, 1<sup>1</sup>/<sub>2</sub> mm long. Wings of fruit 4–7 by 1–2<sup>1</sup>/<sub>2</sub> cm, asymmetric and obovate, inside narrowed or straight, hairy; mericarp proper 8–13 mm long, ovate.

(1) In Malaysia only one genus.

Distr. Cf. fig. 2; in the Malay Peninsula recently collected in the hills near Cameron Highlands (CF. 27181, 27344, 36281, 37745, 45489), in W. Borneo once near Simpang at 27 m (bb 13518) and once in Sarawak (HAVILAND 2092), in the other islands many localities.

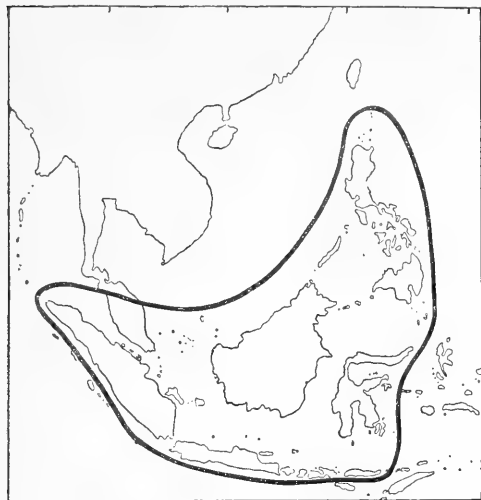


Fig. 2. Distribution of *Acer niveum* BL.; in Borneo and the Malay Peninsula it is very rare.

Ecol. In primary, rarely in secondary or devastated, forests, often common but scattered, 900–2550 m, in Flores descending to 750 m, in Sumatra to 630 m, in Celebes to 450 m, and at only 27 m near Simpang, Borneo. Fls in April–Aug., fr. July–Nov. In *Casuarina* forest saplings have been found. When flowering the leafless crown swarms with *Hymenoptera* collecting honey. Trees are easily located in the forest by the fallen leaves which are glaucous and fine-reticulate-veined underneath.

Vern. Some dozens of native names have been recorded, none of these fixed (HEYNE, *l.c.*).

Uses. Timber unimportant, no distinct heartwood is present; used for building purposes, fit for boxes.

Notes. PAX inserted *A. niveum* in his *sect. Integrifolia* in which the inflor. is terminal on short leafy twigs. I could examine this character in *A. oblongum* WALL. (WALL. 1222 A), *A. laevigatum* WALL. (THOMSON *s.n.*) and '*A. niveum*' (HELPER *s.n.*) from India. *A. niveum* BL. with its axillary leafless inflorescences is, however, possibly related to PAX's *sect. Lithocarpa* and does not belong in *sect. Integrifolia*.

#### Excluded

*Acer javanicum* BURM. f. Fl. Ind. (1768) 221 = *Actinophora fragrans* R.BR. *sec. BACKER in Herb. Bog.*; according to BURRET it is *Colona javanica*, both *Tiliaceae*.

## PHILYDRACEAE (C. Skottsberg, Göteborg)

Erect herbs with a short rhizome. *Leaves* linear radical or crowded at the stem base, distich, equitant, parallel-nerved. *Flowers* zygomorphic, bisexual, solitary in the axil of spathaceous bracts. Perianth corolline, segments 4, 2-seriate. Stamen 1, inserted at the base of the abaxial segments. Filament flattened; anther 2-celled; cells straight or twisted, opening lengthwise by slits. Ovary superior, 3-celled with axile placentas, or 1-celled with parietal placentas. Style simple. Ovules  $\infty$ , anatropous. *Capsule* with 3 valves. Seeds  $\infty$ .

Distr. Centering in Australia, comprises 4 genera with 5 species.

### KEY TO THE GENERA

- |   |                       |
|---|-----------------------|
| 1. Outer tepals free. Anthers spirally twisted. Ovary 1-locular . . . . .       | 1. <i>Philydrum</i>   |
| 1. Outer tepals united at the base. Anthers straight. Ovary 3-locular . . . . . | 2. <i>Helmholtzia</i> |

### 1. PHILYDRUM

BANKS & SOL. *ex* GAERTN. Fruct. 1 (1788) 62; MIQ. Fl. Ind. Bat. 3 (1855) 250; HASSK. Bull. Soc. Bot. Fr. 16 (1869) xxiv; RIDL. Fl. Mal. Pen. 4 (1924) 347; SKOTTSB. Bull. J. B. B. III, 13 (1933) 111.

Outer *tepals* free, inner ones more or less united at the base with the filament. Anther spirally twisted. Pollengrains in tetrads. Ovary 1-locular. *Capsule* loculicid. Testa spirally striate.

Distr. Monotypic, E.-SE. Asia, and Australia, rare in Malaysia.

**1. *Philydrum lanuginosum*** BANKS & SOL. *ex* GAERTN. *l.c.*; MIQ. *l.c.*; HASSK. *l.c.*; BANKS & SOL. Bot. COOK's Voy. 3 (1905) t. 310; MERR. Philip. J. Sc. 10 (1915) Bot. 88; RIDL. *l.c.*; SKOTTSB. *l.c.*; YAMAMOTO, J. Soc. Trop. Agric. 10 (1938) 119; STEEN. J. Arn. Arb. 28 (1947) 420.—Fig. 1.

Perennial caespitose herb, caudex short. *Leaves* densely rosulate, isolateral monofacial, glabrous, thick and of soft texture, 40–80 cm long incl. the sheath; sheath 14–30 by 1–1½ cm and 2–4 mm thick. Scape 1 m high or more, slender, terete, glabrate below, villous towards the woolly inflor., with few cauline leaves gradually passing into the alternate bracts. Inflor. a terminal spike, simple or paniculate. Bracts ovate, clasping, abruptly acuminate and subulate, 2–7 by ¾–1 cm enclosing the buds, reflexed in anthesis, again embracing the fruit. *Flowers* sessile, yellow. Perianth thin, outer tepals 12–15 by up to 10 mm, acute,  $\infty$ -nerved, long-villous outside, margins inflexed, the posterior with 2 stronger veins and bidentate; inner petals

united below 1–2 mm with the filaments, 8 by 2 mm 3-nerved, spatulate, base hairy outside. Stamen 8–9 mm, glabrous; anther  $\pm$  spherical, 1½ mm across. Ovary 6–7 by 2–3 mm, densely long-woolly; style 3–4 mm, glabrous; stigma broad-triangular long-papillose. *Capsule* triangular-oblong, 9–10 by 4–5 mm. Seeds  $\infty$ , dark-reddish, bulb-shaped, 0.8–0.9 by 0.3–0.4 mm.

Distr. E. to SE. Asia (Riu Kiu Isl., Formosa, Kwantung, Hongkong, Indo-China, Siam, Burma, Andaman Isl.) and NE. Australia, in *Malaysia*: only in the Malay Peninsula, and in SE. New Guinea, to be expected locally elsewhere.

Ecol. In ponds, marshes, and rice-fields at low altitude, in New Guinea in sedge swamps and moist savannahs.

Notes. According to MERRILL (1915) the CUMING specimen credited to the Philippines came from the Malay Peninsula; the HILLEBRAND specimen is certainly erroneously believed to occur wild in Java.

### 2. HELMHOLTZIA

F. v. M. Fragm. 5 (1866) 202; SKOTTSB. Bot. Jahrb. 65 (1932) 260; Bull. J. B. B. III, 13 (1933) 112.

*Tepals* united to form a short cupular tube, the inner connate to half their length with the filament. Anther straight. Pollen grains single. Ovary 3-locular. *Berry* leathery, (apparently) indehiscent. Seed with long funicle, outer testa lengthwise striate and not spirally so.

Distr. 2 species, one in Australia, the other in *E. Malaysia*.



Fig. 1. *Philydrum lanuginosum* BANKS,  $\times \frac{2}{5}$  (after BANKS & SOLANDER).

1. *Helmholtzia novoguineensis* (KRAUSE) SKOTTSB. *Il.cc.*; STEEN. J. Arn. Arb. 28 (1947) 419.—'Xerotidae sp.' TEYSM. Nat. Tijds. N.I. 37 (1877) 132–133.—'Liliacea' J. J. SMITH, Teysm. 12 (1902) 168, 329.—*Astelia novoguineensis* KRAUSE, Bot. Jahrb. 59 (1924) 559.

Perennial herb. Rhizome stout, ascending to erect, woody, covered with leaf sheaths, up to 35 by 1–1½ cm; roots coarse, shoots flat, fan-shaped. Leaves densely rosulate, ensiform, 75–150 by 3–4½ cm; sheath 20–30 cm long, inside with scanty very long thin arachnoideous hairs, linear, acute, glabrous, of firm texture, a bundle veins on each side forms a prominent costa dissolving to the apex, with short oblique transverse veins; blade monofacial arched or horizontal, with secondary upper and lower surface. Scape terminal 25–50 cm, erect, obtuse-angular, upwards covered with a dense light-grey wool, leafless in its lower half, thence carrying 5–10 reduced ensiform leaves or spathes passing into bifacial alternate bracts. Branches of 1st order of the panicle supported by a spathe, the largest 10–40 by 1½–3 cm, 2–3 lowermost with few branchlets of 2nd order 2–8 cm long. Bracts linear subulate 1–2 by ¼–½ cm, 1–3-nerved, base woolly convolute enclosing the bud. Flowers sessile, white,

glabrous except the 2–2½ mm high tube. Outer tepals narrow-triangular, convolute with filiform apex, posterior one bicarinate-bicuspidate, with inflexed margins, 9–12⅓ by 4–5 mm, anterior one 8–11 by 2½–3½ mm. Inner tepals and filament adnate to the tube, small, 1-nerved, 4–5 mm long, irregularly 3-dentate, free portion 1½–2½ by ¾–1½ mm. Free part of the stamen ¾–3¾ mm; anther 2–2½ by 1–1½ mm. Ovary 2 by 1 mm densely grey-woolly. Style 3-sulcate, 2¾–4½ mm long, stigma small triangular. Berry white, slightly 3-sulcate, 7–8 by 6 mm, pericarp tough leathery. Seeds ∞, 2–2¼ by ½ mm, cylindrical-flattened, often slightly curved, dark-brown with a transparent striate outer testa prolonged at both ends.

Distr. *Malaysia*: Moluccas (Ambon, Boeroe, Ceram) and New Guinea, 600–1500 m.

Ecol. In groups in muddy or moist, humic open spots in rain forests, and along ponds and margins of lakes. *Fl. & fr.* throughout the year.

Notes. Closely allied to *H. acorifolia* F. v. M. from E. Australia, which has an almost glabrous scape, a more robust habit, a trifle smaller flowers, outer petals hairy on the back, style 5–6½ mm long, seeds mostly a little less than 2 mm.



# ANCISTROCLADACEAE (C. G. G. J. van Steenis, Buitenzorg)

## ANCISTROCLADUS

(WALL. Cat. (1832) 1052) *ex* ARNOTT, Nov. Act. 18 (1836) 325; PLANCH. Ann. Sc. Nat. III, 13 (1849) 316; SCHEFF. Nat. Tijds. N. I. 32 (1873) 407; BOERL. Handl. 1 (1890) p. XVII, XX; KING, J. As. Soc. Beng. 42, II (1893) 137; MASSART, Ann. J. B. B. 12 (1895) 121; GILG, in E. & P. ed. 2, 21 (1925) 589, f. 269-70; RIDL. Fl. Mal. Pen. 1 (1922) 250.—*Bembix* LOUR. Fl. Coch. (1790) 282, *nom. rej.*, *cf.* MOORE, J. Bot. 65 (1927) 279.—*Wormia* VAHL, Skrift. Nat. Selsk. Kjöbenh. 6 (1810) 104, *non* ROTTB.—*Bigamea* KOEN. *ex* ENDL. Gen. Pl. 1183 (1840).

Scandent shrubs (often erect in youth), without resin; branches sympodial with a series of circinate woody hooks in one plane. *Leaves* spread, simple, entire, often rosette-crowded, cuneiform, penninervous, reticulate-veined, glabrous, both surfaces minutely pitted, each pit with a peltate small hair secreting a wax-like substance; petiole articulated, scar on the twigs often saddle-shaped; stipules absent. *Flowers* ♀, actinomorphic small. Inflorescence few or several times dichotomous or spike-like, often provided with said hooks and single reduced bract-like leaves, branches often recurved. Pedicels articulated. Bracts with a glandular-thickened base, margin fimbriate-membranous. Calyx tube short, at length adnate to the base of the ovary; lobes 5 inequal imbricate, enlarged and wing-like in fruit. Petals 5, united at the base, slightly contorted in bud. Stamens mostly 10, rarely 5, the episepalous slightly longer. Filaments with broadened base; anthers basifixed,  $\pm$  introrse to  $\pm$  latrorse, 2-celled, opening lengthwise. Ovary for the greater part inferior, consisting of 3 carpels, 1-celled, protruding into a nipple-shaped elongation bearing 3 articulated erect styles with a punctiform or horse-shoe-shaped stigmatic apex; nipple enlarging in fruit. Ovule 1, basal, ascending, with 2 integuments. *Nut* not dehiscent, crowned by the enlarged calyx. Seed roundish with testa intruding between the cerebral-like folds of the endosperm. Exocarpe leathery. Embryo straight, erect, obliquely placed; cotyledons diverging; hypocotyl rather thick.

Distr. Disjunct, *ca* 3 spp. in trop. W. Africa, and 9 in SE. Asia, from the Deccan to Burma, Indochina, Hainan, S. China, the Malay Peninsula, Borneo and Sumatra (*cf.* fig. 2).

Uses. Except for some local information nothing is known (*cf.* BURKILL).

Ecol. In mixed rain forests, but most common on silicious soil in so-called 'padang-scrub', from the lowland to the hills. KERR noted of *A. wallichii* (his no 7006) that all specimens grew erect, and it is reported by GAGNEPAIN to be erect in youth. RIDLEY also found it on the ground as a bush, or ascending trees, and this is also observed in specimens from Sumatra and Borneo. In the open padang-scrub it is either erect or trailing.

Notes. This monogeneric family has been subsequently been referred to several families; it is now mostly placed next to the *Dipterocarpaceae* but differs by the 1-celled ovary, basal ovule, peculiar endosperm, climbing habit, sympodial structure, absence of stipules, and presence of hooks. HALLIER *f.* brought it to the *Linaceae-Hugoniaceae*, suggested already by MIQUEL. The bark of the twigs shows a peculiar cracking *viz* lengthwise superficial splitting of the thin grey corky outer bark and further by deeper transverse cracks. In *A. extensus* I found peculiar rather large crateriform glands on the base of the bracts of the inflorescence. Similar glands I found on 2-3 or all 5 sepals, distinctly elevated, 1-3 together. I have not found any stipules, neither in *A. extensus* nor in abundant living material of *A. hamatus* (VAHL)GILG; there are rather large bracts leaving scars amidst the leaf-tufts but these belong apparently to the leaf-spiral. GAGNEPAIN (Fl. Gén. I. C. 1 (1910) 393) mentions 3-5 styles, but I found only 3. HUTCHINSON (Fam. Fl. Pl. 1 (1926) 178) apparently assumes the style to be represented by the nipple-shaped extension of the ovary above the calyx on tip of which 3 free stigmas are articulated, but the tip of the latter I found distinctly 'stigmatic papillose' so that I assume the styles to be articulated with the ovary. The stigmatic surface is punctiform or horse-shoe-shaped. The nipple enlarges in fruit and forms a distinct part of it. All authors assume the presence of a ruminant endosperm, but HUTCHINSON

denies its presence and assumes the embryo to be constituted of remarkably 'folded cotyledons'. I had no seedlings at my disposal but an examination of the seeds did not confirm HUTCHINSON'S statement. The embryo is lying loose in the endosperm.

The flowers are mostly deficient or absent in our rather rich material and when drying shrink to poor and brittle remnants. However, in *A. extensus* I found laterally slit anthers and not introrse cells, contrary to GAGNEPAIN'S statements. BOERLAGE mentions slits which are turned somewhat towards the inner surface.

The size of the leaves varies much both in shape and dimensions in one specimen, specially between sterile and fertile twigs. In cultivated *A. hamatus* I found leaves of flowering twigs 6–9 by 2–2½ cm, and those of sterile twigs 35–40 by 4½–5½ cm. Notwithstanding the scanty flowering material I am perfectly satisfied that only one species occurs in Malaysia.

**1. *Ancistrocladus tectorius* (LOUR.) MERR.** Lingn. Sc. J. 6 (1930) 329; Comm. Lour. (1935) 275.—*Bembix tectoria* LOUR. Fl. Coch. (1790) 282.—*A. extensus* (WALL. Cat. 1052, *nomen*) PLANCH. Ann.

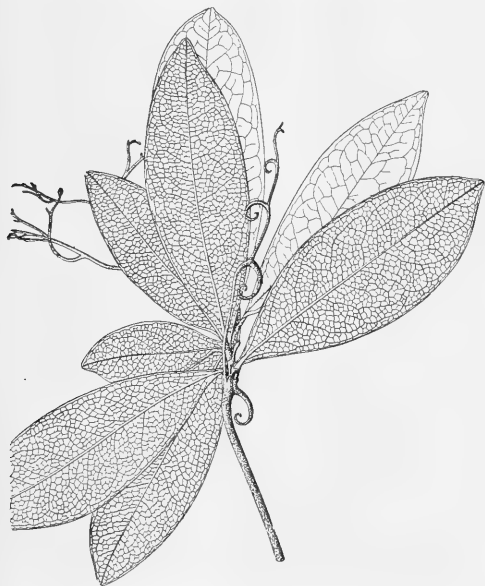


Fig. 1. *Ancistrocladus tectorius* (LOUR.) MERR.,  
[from Borneo,  $\times 2/5$ .

Sc. Nat. III, 13 (1849) 318; KING, J. As. Soc. Beng. 42, II (1893) 137; BOERL. Cat. pl. phan. Hort. Bot. Bog. pt 2 (1901) 114; BURK. Dict. (1935) 155.—*A. pinangianus* (WALL. Cat. 1054, *nomen*) PLANCH. l.c.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 587; SCHEFF. Nat. Tijds. N.I. 31 (1870) 348; 32 (1873) 407; DYER, in HOOK. f. Fl. Br. Ind. 1 (1874) 300; RIDL. Fl. Mal. Pen. 1 (1922) 251, f. 25.—*A. extensus* var. *pinangianus* KING, J. As. Soc. Beng. 42, II (1893) 137; GAGN. l.c.; CRAIB, l.c.—*A. hainanensis* HAYATA, Ic. Pl. Form. 3 (1913) 46.—Fig. 1–2.

Liana, in the youth and in open scrub often a shrub, later often trailing; main shoots provided with scattered  $\pm$  erect small leaves, between and near which arise spreading non-foliate tendril-like shoots provided with 3–6 curved hooks, lower 2 rarely 3 hooks getting woody, hooks mostly unilateral, rarely 1–2 alternate; these 'tendrils' later woody, becoming branches, upper part vanishing.

Leaves crowded mostly immediately above the 2nd hook, variable in size and shape, sessile, mostly obovate-oblong, tapering towards the base, apex obtuse, rounded, acute or even acuminate, blade 9–30 by 3–10 cm; nerves 4–8 on either side, spreading, connected by a slightly looped intramarginal vein and a 2nd feebler outer one, rather straight, numerous secondary veins often becoming as strong as the main nerves and parallel. Inflor. between the crowded leaves, very rarely lateral in the place of a 'tendrill' on the main shoot, repeatedly dichotomous, branches divaricate, 8–15 cm long. Flowers rather crowded at their tips. Calyx lobes unequal, oval, thin-margined, glabrous except the

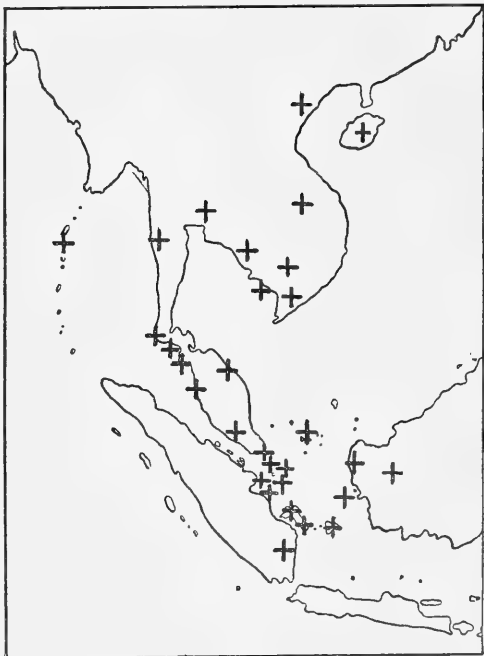


Fig. 2. Localities of *Ancistrocladus tectorius* MERR.

short ciliate rounded apex, some or all lobes provided with 1–3 conspicuous crateriform prominent glands, mostly shorter than the corolla, 1¾–2½ mm long, soon enlarging. Petals oblique-oval, one margin often involute, acute, 3–3½ by 1¾ mm. Styles erect, nearly as long as the nipple-shaped ovary-

top, both  $1\frac{1}{2}$  mm high, stigma punctiform. Stamens alternately unequal; filament broadened at the base; cells free, acute, more or less latrorse. Fruit with spreading calyx wings slightly decurrent on the obconical sub-5-angular smooth tube, oblong-cuneate to spatulate, unequal, often oblique, apex blunt to rounded, with 3 larger nerves and numerous smaller densely reticulate ones, overlapping at the base, smallest mature ones measured  $2\frac{1}{2}$  by  $1\frac{1}{2}$  cm, largest 5 by  $1\frac{3}{4}$  cm; nipple broad-obcampanulate,  $\pm$  3 mm high protruding, solid, not filled with part of the seed. Seed obconical with flat apex, ca 5 mm high, mostly consisting of a ruminant endosperm; germ ca  $2-2\frac{1}{2}$  mm high, erect, straight, obliquely inserted.

Distr. Burma, Siam, the Andamans, and Indochina to S. China and Hainan, in *Malaysia*: Malay Peninsula, Riouw & Lingga Arch., Anambas Isl., W. Dutch Borneo, Karimata, Banka, Billiton, once collected in S. Sumatra (fig. 2).

Ecol. Low altitude, often near the sea, sometimes on the margin of the beach, mostly on sili-

cious soils, both in mixed forest and padang scrub fr. fl. March-Aug.

Vern. *akar (be)boeloes*, *beloeloes*, *meloeloes* (Banka), *mendjoeloeng* (Lepar), *troeng boeloes* (Billiton).

Notes. I agree with BURKILL that no differences of importance can be found between *A. extensus* and *A. pinangianus*. I have tentatively accepted MERRILL's name, though MOORE stated that the type in the Br. Mus. is inadequate for specific identification. It was collected in the classical locality but I am not satisfied that no other species grows there; in tropical regions the identification 'by exclusion' is a somewhat dangerous procedure.

#### Excluded

*Ancistrocladus pentagynus* WARB. Bot. Jahrb. 13 (1891) 385 = *Durandea* (Linac.) acc. to HALLIER f. (B.B.C. 39, II (1921) 68-78).

*Ancistrocladus sagittatus* WALL. = *Tetramerista glabra* MIQ. (Theac.).

# APONOGETONACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. APONOGETON

LINNÉ *f.* Suppl. (1781) 32; ENGL. & KRAUSE, Pfl. R. 24 (1906).

Perennial lactiferous freshwater herbs, rhizome short tuberous with fibrous roots. *Leaves* radical, submerged or floating, base sheathing, oblong to linear, entire or crisped, often long-petiolate; nerves lengthwise parallel, connected by numerous oblique transverse veins. Spike emerging from the water, simple or 2–8-forked, without bracts, subtended by a mostly caducous basal sheath (spathe). *Flowers* bisexual (rarely by abortion unisexual), small, spicate-scapose, white, rose, purple, yellow or yellowish-green. Perianth segments 2 (1–3, or absent), equal or unequal, usually persistent. Stamens in 2 rows, 6 (or more), free, hypogynous, persistent; filament filiform; anthers extrorse, small, 2-celled. Pollen subglobose or ellipsoid. *Gynaecium* superior, apocarpous; carpels 3–6, sessile, each with a simple style. Ovules 1–8 (or more), anatropous. Mature carpels inflated, opening along the back. Seeds without endosperm; outer testa often loose; embryo straight, elongate.

Distr. About 40 *spp.* described, Africa, Madagascar, Ceylon, SE. Asia, through Malaysia (very rare) to N. Australia, centering in Africa and Madagascar.

Ecol. The few Malaysian specimens were collected in lowland stony streams both on calcareous and other rock. The testa contains in some *spp.* air between the two coats and float on the water; it soon decays and the embryo sinks to the bottom.

Uses. The starchy tuberous rootstock is said to be edible in some *spp.*

Notes. Monogeneric family. Next to the single indigenous species, *A. fenestralis* with its unique fenestral-leaved foliage is cultivated in the Bot. Gard. Buitenzorg, and may be found in private gardens as a curiosity.

1. *Aponogeton loriae* MARTELLI, Nuovo Giorn. Bot. Ital. II, 3 (1897) 472, t. 8; ENGL. & KRAUSE, Pfl. R. 24 (1906) 12; DOMIN, Bibl. Bot. 20 (1915) 254; CAMUS, Bull. Soc. Bot. Fr. 70 (1923) 672–3; RENDLE, J. Bot. (1923) Suppl. 58; STEEN. Journ. Arn. Arb. 28 (1947) 419.—*A. crispus* (non THUNB.) F. v. M. Descr. Not. Pap. Pl. 8 (1886) 51; RIDL. J. Bot. 24 (1886) 359.—*A. monostachyum* (non L. f.) HEMSL. Kew Bull. (1899) 113.—Fig. 1.

*Submerged*; rootstock roundish  $\frac{1}{2}$ –1½ cm. *Leaves* green or brown, distinctly petiolate (2–15 cm), blade linear-spathulate, 10–35 by 1–4 cm, mostly gradually tapering into the petiole, base narrow-cuneate, apex rather broadly cuneate and ± blunt, primary nerves 2 on both sides and a marginal vein; parenchyma opaque dotted brown-punctate; margin slightly undulate-crisped to ± flat. Scape 5–40 cm. *Spathe*  $\frac{1}{2}$ –1½ cm long, ovate-acute, lengthwise nerved, persistent, decaying gradually from the apex towards the base, green, concave, subamplexicaulous, apex mucronulate. *Flowers* greenish-yellow, the lower ones over 2–3 cm densely set and

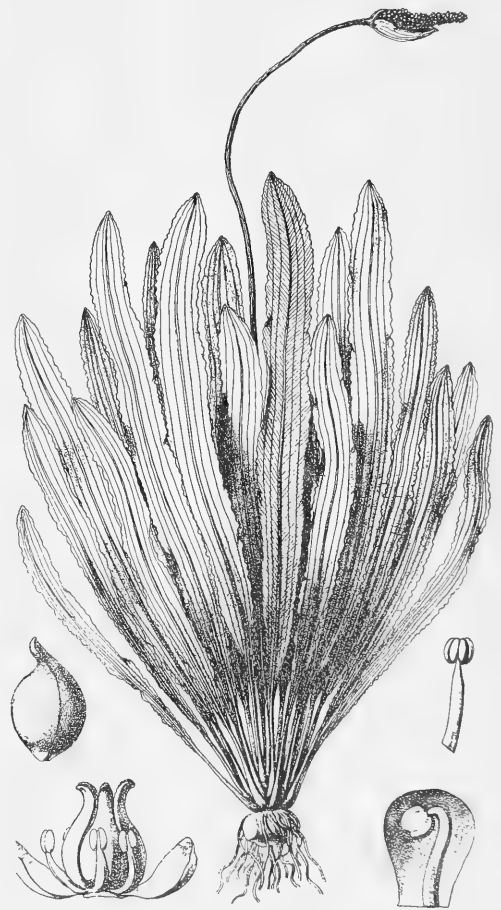


Fig. 1. *Aponogeton loriae* MARTELLI. Plant  $\times \frac{1}{2}$ , flower, tepal with stamen, stamen, and fruit enlarged (after MARTELLI).

with developing fruits, stamens about equaling the tepals on 2 mm long filaments, the upper ones rather abruptly as it seems male with 3 mm long stamens, very small ovaries and flowers set laxly to remote. Spikes  $1\frac{1}{2}$ –7 elongating in flower up to 18–20 cm. Tepals obovate *ca*  $1\frac{1}{2}$ – $1\frac{3}{4}$  by  $1$ – $1\frac{1}{4}$  mm, concave, apex broadly rounded. Stamens 6; anthers roundish oval, no dehiscent ones observed by me. *Carpels* 3, *ca*  $2\frac{1}{2}$  mm long, ovate,  $\pm$  bluntly trigonous, rather abruptly beaked by a distinct recurved rostrate style about  $\frac{1}{2}$  mm long. Seeds (in TEYSMANN 12792) 1–6 with a delicate loose outer coat 6-winged or -ribbed, transparently brown-reticulate-netted-celled, 2 by  $\frac{2}{3}$  mm. Inner testal

coat oblong, opaque, darkbrown, smooth,  $1\frac{1}{4}$  by  $\frac{1}{2}$  mm, closely enveloping the straight embryo, easily splitting on slight pressure, rounded at both sides.

Distr. Queensland (DIELS 8397, *n.v.*), in *Malaysia*: New Guinea, and SW. Celebes in the calcareous Maros-Pangkadjene distr. (TEYSMANN 11901, 12792).

Ecol. In shallow stony streams in forests and savannahs, 100–600 m.

Notes. There is a remarkable yet unexplained dimorphism in the flowers of the spike, the lower ones setting fruit only and differing in length of anthers.

## BURMANNIACEAE (F. P. Jonker, Utrecht)

Annual or perennial, saprophytic or autotrophic herbs; the saprophytic species often colourless. *Leaves* usually spread or alternate, entire, simple, without stipules; non-saprophytic species with a radical rosette of linear leaves; stem leaves often reduced to small scales; sometimes the basal part of the stem provided with many decurrent, grass-like leaves. *Flowers* ♂, usually actinomorphic, solitary or in capitate or cymose inflorescences. Perianth corolline; limb consisting of 2 whorls; tube sometimes 3-winged. Anthers 3, subsessile in the perianth throat and dehiscing laterally with horizontal slits, or 6, hanging down in the perianth tube and dehiscing with longitudinal slits. Connective large, often appendiculate. Style filiform or shortly cylindrical or conical. Stigmas 3, sometimes connate. Ovary inferior, 1-celled with parietal placentation, or 3-celled with axile placentation. Ovules ∞, anatropous, with 2 integuments; funicles often rather long. *Fruit* usually capsular, sometimes fleshy, crowned by the persistent perianth tube and the style, or by a thickened persistent basal ring of the perianth tube, dehiscing irregularly or with transverse slits at the top. Seeds ∞, small, subglobose to linear, sometimes with loose, reticulate testa, with endosperm.

*Distr.* About 125 species, widely distributed in the tropics of both hemispheres, also in subtropical America, Chicago area, Moçambique, Southern China, Japan, Southern Australia, New Zealand and Tasmania. As many species are rare, it is possible that only a part of their area is known. Most of them are found in moist regions. Among the autotrophic Malaysian *Burmanniaceae* there are 3 rather common species which are widely spread, viz *Burmattia coelestis*, *B. disticha* and *B. longifolia*. The latter two are absent from Java and the Lesser Sunda Islands, the former occurs in Java proper only in its western part. Of the saprophytic Malaysian species only 3 have been often collected, viz *Burmattia championii*, *B. lutescens*, and *Gymnosiphon affinis*.

*Ecol.* The autotrophic species provided with green leaves occur in grass-fields, along road sides and river-banks, among brush-wood and in forests or on moist swampy soil, up to about 3000 m alt. The saprophytic species usually occur in dense primary or secondary forests on soils rich in humic matter by decaying wood and leaves, up to ca 1500 m alt. They are also found sometimes in bamboo bushes and parks.

*Notes.* Treatment mostly after JONKER, A monograph of the Burmanniaceae, Thesis, Utrecht, 1938; also in: Meded. Bot. Mus. & Herb. Utrecht no 51; slightly revised.

In collecting *Burmanniaceae* it is necessary to collect plants with complete flowers, as the limb with the stigmas and stamens is often caducous. The fruits are also important. The colour of the flowers, stems and leaves must be noted. Preservation of collections in 60 % spirits is recommended.

In the field the saprophytic species are often found in colonies together with other saprophytic plants belonging to the *Orchidaceae*, *Triuridaceae*, and *Gentianaceae*. From the extreme rarity of a number of species it may be assumed that by further collecting these tiny plants several novelties will be found.

### KEY TO THE GENERA

1. Perianth tube cylindrical or trigonous, persistent on the capsule. Style of equal length as the tube. Anthers 3, subsessile in the perianth throat. Thecae dehiscing laterally with transverse slits  

TRIBE *Burmannieae* MIERS

  2. Ovary and capsule 3-celled with axile placentation. Perianth as a whole persistent on the capsule. Ovary and perianth often prominently 3-winged, sometimes 3-costate or wingless. Ovary without glands. Capsule mostly dehiscing irregularly . . . . . **1. *Burmattia***
  2. Ovary and capsule 1-celled with parietal placentation. Perianth limb with the stamens and stigmas deciduous. Ovary and perianth wingless. Both sides of the top of each placenta inside the ovary provided with a gland. Capsule reticulate-perforated . . . . . **2. *Gymnosiphon***
1. Perianth tube urceolate, circumscissile, only a small basal ring persistent on the fruit. Style very short, cylindrical or conical. Anthers 6, hanging down in the tube. Thecae dehiscing introrsely with longitudinal slits  

TRIBE *Thismieae* MIERS

  3. Inner perianth lobes free, or converging at their tops or connate to a mitre with 3 holes, the latter without appendages at the apex . . . . . **3. *Thismia***
  3. Inner perianth lobes connate to a mitre with 3 holes, crowned by 1 or 3 appendages.
  4. Mitre crowned by 3 erect, thick, filiform appendages, clavately swollen at their tops . . . . . **4. *Geomitra***
  4. Mitre crowned by 1 erect thick column, bearing at its apex 3, more or less connate, glandular lobes . . . . . **5. *Scaphiophora***

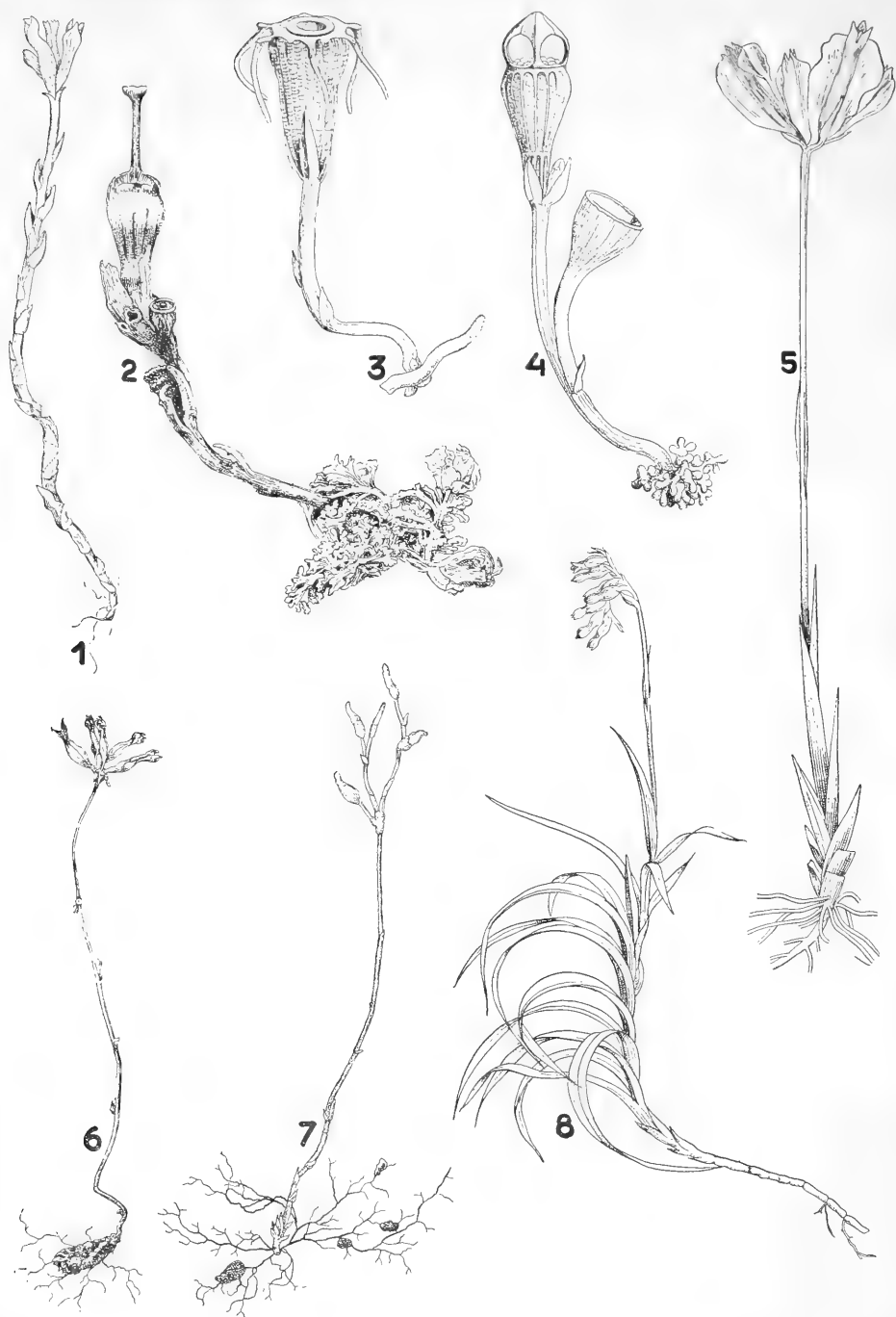


Fig. 1-8. Burmanniaceae. 1. *Burmannia bifaria* J. J. S.,  $\times \frac{1}{1}$ , 2. *Scaphiophora gigantea* JONK.,  $\times \frac{1}{3}$ , 3. *Thismia aseroe* BECC.,  $\times \frac{8}{5}$ , 4. *Th. episcopalis* (BECC.) F. v. M.,  $\times \frac{2}{3}$ , 5. *Burmannia coelestis* DON,  $\times \frac{3}{2}$ , 6. *Burmannia championii* THW.,  $\times \frac{1}{1}$ , 7. *Gymnosiphon aphyllus* BL.,  $\times \frac{2}{3}$ , 8. *Burmannia longifolia* BECC.,  $\times \frac{2}{5}$ .

1. BURMANNIA

LINNÉ, Sp. Pl. ed. 1 (1753) 287; JONKER, Monogr. (1938) 18, 57.

Annual or perennial, saprophytic and colourless or chlorophyllose. Flowers often 3-winged. *Perianth* limb usually consisting of 6 lobes; the outer ones being much larger; inner 3 often minute, sometimes lacking. *Perianth* tube cylindrical to trigonous. *Anthers* 3; connective sometimes with 2 apical crests and/or a hanging, median, basal spur. *Style* filiform, branching into 3 short branches, each bearing a stigma, or 3 sessile stigmas at the apex of the style. *Ovary* trigonous. *Fruit* capsular, mostly dehiscent irregularly. *Seeds* many, oblong or ellipsoid.

Distr. 57 species, tropics of both hemispheres, also in the S. United States, S. part of S. America Moçambique, S. China, Japan and S. Australia.

KEY TO THE SPECIES

- 1. Perennial, leafy green herbs. Greater part of the stem beset with grass-like, linear or ensiform, decurrent, imbricate leaves. Inflorescence usually many-flowered. Flowers hanging, very narrowly 3-winged in the basal part . . . . . (SECT. *Foliosa* JONK.). 1. *B. longifolia*
- 1. Annual or perennial, saprophytic or green herbs. Stem leaves reduced to small scales. The non-saprophytic species with a radical rosette of linear leaves. Stem usually 1- to few-flowered. Flowers erect . . . . . (SECT. *Euburmannia* MALME)
- 2. Non-saprophytic, chlorophyllose herbs with a rosette of green leaves at the base; rosette often consisting of only 1-3 leaves.
- 3. Flower wings narrower than the perianth tube or reduced to ribs.
- 4. Basal rosulate leaves few. Stem bearing 1-2 flowers at its apex. Connective with 2 apical crests, basal spur lacking. Ovary as long as the perianth or longer . . . . . 2. *B. geelvinkiana*
- 4. Basal rosette well developed. Stem bearing at its apex a usually bifid inflorescence. Connective provided with 2 apical crests and a basal, hanging spur. Ovary shorter than the perianth . . . . . 3. *B. bancana*
- 3. Flower wings as wide as the perianth tube or wider.
- 5. Margin of the perianth lobes double. Connective with a basal hanging spur and 2 apical crests. Thecae separated.
- 6. Robust herbs with a well developed rosette of grass-like, up to 15 cm long leaves. Inflorescence usually a bifid, many-flowered cyme . . . . . 4. *B. disticha*
- 6. Slender herbs. Basal rosulate leaves about 1 cm. Stem bearing at its apex a single flower or a cluster of few flowers . . . . . 5. *B. coelestis*
- 5. Perianth lobes with single margin. Connective with 2 apical crests; basal spur lacking. Thecae connate below the basal connective margin . . . . . 6. *B. connata*
- 2. Saprophytic herbs without chlorophyll. Radical rosette absent.
- 7. Flowers wingless, 3- or 6-costate.
- 8. Stem scales many, imbricate in the lower part of the stem. Ovary as long as the perianth or longer . . . . . 7. *B. sphagnoides*
- 8. Stem scales not imbricate. Ovary shorter than the perianth.
- 9. Flowers 6-costate. Perianth limb thick, fleshy, more or less succulent . . . . . 8. *B. bifaria*
- 9. Flowers 3-costate to narrowly 3-winged. Limb not fleshy.
- 10. Inflorescence usually capitate. Inner perianth lobes spatulate, sometimes slightly papillose. Connective mucronate at the apex, obtuse at the base . . . . . 9. *B. championii*
- 10. Flowers usually pedicellate. Inner perianth lobes broadly obovate, distinctly papillose. Connective not mucronate, acute at the base . . . . . 10. *B. micropetala*
- 7. Flowers 3-winged.
- 11. Inner perianth lobes absent.
- 12. Perianth lobes simple. Connective with an apical, papillose crest and a basal, hanging, obtuse spur . . . . . 11. *B. tridentata*
- 12. Perianth lobes bifid. Connective without crest and spur . . . . . 12. *B. oblonga*
- 11. Inner perianth lobes not lacking, sometimes very small.
- 13. Very delicate plants. Connective with a basal, hanging spur . . . . . 13. *B. steenisii*
- 13. Plants not very delicate. Connective without basal, hanging spur.
- 14. Stem rather robust, often many-flowered. Inner perianth lobes minute, orbicular. Flower wings variable, linear to half cuneate or quadrangular . . . . . 14. *B. lutescens*
- 14. Slender herbs, usually 1-flowered. Inner perianth lobes lanceolate. Flower wings elliptical . . . . . 15. *B. malasica*



**1. *Burmattia longifolia* BECC.** Malesia 1 (1877) 244; JONKER, Monogr. (1938) 20, 59.—*B. leucantha* SCHLTR. Bot. Jahrb. 49 (1913) 107.—Fig. 8.

Perennial, 12–50 cm. Stem usually simple, forked at the top into the bifid inflorescence or bearing a simple cincinnus. *Leaves* linear, sometimes keeled, decurrent, stem-clasping, acute, sometimes subulate, parallel-veined but midrib more prominent, growing smaller towards the top, 4–20 cm by 2–9 mm. Upper part of stem beset with appressed, scattered, lanceolate, acute scales, 5–33 mm. Basal part of stem with brownish, dried leaves. Inflorescence 32–1-flowered, branches up to 4 cm. Bracts scale-like, linear-lanceolate, 5–10 mm. *Flowers* subsessile, hanging, white, often with pale-violet or bluish limb, 8–16 mm. Outer perianth lobes deltoid, acute, 2–4½ mm; margin fleshy at the base. Inner ones broad-obovate to orbiculate, entire and rounded, or retuse, or bilobate, 1½–2 mm. Perianth tube cylindrical, sometimes swollen in the upper part, 3–5 mm; lower part of tube and ovary very narrowly 3-winged. Stamens inserted just below the inner perianth lobes. Connective broad, oblong, crowned by two, rather wide crests. Filaments short, broad. Style thick, branching into 3 very short branches, each bearing a curved funnel-shaped stigma. Ovary obovoid, 4–7 mm. *Capsule* obovoid, dehiscing transversally, irregularly. Seeds oblong to scobiform, appendaged at both sides; testa loose, reticulate.

Distr. All over *Malaysia*, except Java and the Lesser Sunda Islands.

Ecol. In mountain forests, brush-wood, along mossy trails, often on ridges, scattered, ascending to 2800 m alt.

**2. *Burmattia geelvinkiana* BECC.** Malesia 1 (1877) 244; JONKER, Monogr. (1938) 111.

Annual, 7–12 cm. Stem filiform, simple, bearing 1 or, sometimes, 2 flowers. Rosulate *leaves* 2–5, linear, subulate, 3-nerved, 3–5 mm by 1 mm. Stem leaves scale-like, appressed, linear-lanceolate, acuminate to subulate, up to 3 mm. Bracts ovate-lanceolate, long-acuminate, 3-nerved, 1½ mm. *Flowers* bluish, very narrowly 3-winged, 7 mm. Outer perianth lobes triangular to broad-ovate, apiculate, about 1½ mm. Inner ones linear, obtuse, ½–1 mm. Connective thick, triangular, obtuse at the base, bearing two divergent, slightly papillose crests at the apex. Style rather short and thick, bearing 3 sessile, funnel-shaped stigmas; style with stigmas about 1½ mm. Ovary ellipsoid to narrowly obovoid, about 4 mm. Flower wings linear, about 5½ mm by ¼ mm. *Capsule* obovoid, dehiscing with transverse slits. Seeds ovoid, bright yellow.

Distr. *Malaysia*: West New Guinea (Wandamen Peninsula, Geelvink Bay), once collected.

**3. *Burmattia bancana* MIQ.** Fl. Ind. Bat. Suppl. 1 (1860) 617; JONKER, Monogr. (1938) 24, 113.—*B. graminifolia* WARB. in FEDDE, Rep. 18 (1922) 330.

Annual, 20–37 cm. Stem simple, terete, forked into the inflorescence. Rosette distinct; *leaves* many, linear to lanceolate, subulate, parallel-veined, 2½–7 cm by 6 mm. Stem leaves few, scale-like, ap-

pressed, lanceolate, subulate, 1–3 cm. One rosette sometimes bearing 2 or 3 stems. Inflorescence a double cincinnus, 3- to 5-flowered; branches up to 3 cm. *Flowers* blue or purplish, narrowly winged, 6–13 mm. Outer perianth lobes lanceolate-triangular, acute, with 3 prominent, fleshy nerves inside, up to 3 mm. Inner ones linear-lanceolate, obtuse, up to 2½ mm; midrib prominent, fleshy. Perianth tube cylindrical-trigonus, up to 4½ mm. Connective oblong, provided with a basal, hanging, obtuse spur and 2 apical, divergent obtuse crests. Style filiform, branching into 3 short branches, each bearing a slightly curved, funnel-shaped stigma. Ovary truncate-ellipsoid, 3–7 mm. Flower wings linear, 11 by ½–1 mm. *Capsule* ellipsoid to obovoid. Testa of the seeds elongate.

Distr. *Malaysia*: Sumatra, Banka, Billiton, Borneo.

Ecol. Wet places, along streams, &c.

Vern. *Roempoet taroem*, *oemboet oemboet* (Billiton).

**4. *Burmattia disticha* LINNÉ,** Spec. Plant. 1 (1753) 287; JONKER, Monogr. (1938) 115.—*B. distachya* R. Br. Prod. Fl. Nov. Holl. 1 (1810) 265.—*B. sumatrana* MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 616.—*B. disticha* var. *sumatrana* HOOK. f. Fl. Br. Ind. 5 (1888) 664.

Robust annual, up to 75 cm. Stem usually simple, forked into the inflorescence. Rosette distinct; *leaves* linear or lanceolate, acute, up to 15 cm by 13 mm. Stem leaves reduced to appressed, lanceolate, acute or acuminate scales, up to 7 cm by 7 mm, imbricate in the lower part of stem; upper part of stem often leafless. Inflorescence branches up to 8 cm. Bracts lanceolate, acute, about 5–12 mm. *Flowers* sessile or shortly pedicellate, blue or purplish, often with yellow-tipped, greenish lobes, rarely yellow, 10–20 mm. Outer perianth lobes triangular, acute, 2½ mm; margin thick, double in the basal part. Inner lobes linear-lanceolate, fleshy, obtuse, 1–1½ mm. Perianth tube cylindrical-trigonus, 3–4½ mm. Connective broad, provided with 2 distinct, acute apical crests and a broad, obtuse to almost truncate, basal, hanging spur. Style thick-filiform, bearing 3 sessile, funnel-shaped stigmas; style with stigmas about 3 mm. Ovary ellipsoid to obovoid, truncate, attenuate towards the base, up to 1 cm. Flower wings elliptical, 10–18 by 1½–2½ mm, continuing as crests on the back of the outer perianth lobes, decurrent along the short pedicel. *Capsule* obovoid, truncate, irregularly dehiscing with transverse slits.

Distr. Widely distributed in the tropics of Asia and Australia: Ceylon, India, Siam, Indo-China, China, through *Malaysia* to Australia, in *Malaysia* hitherto not found in Java, the Lesser Sunda Islands, Moluccas, and Philippines.

Ecol. A species with a large ecological amplitude. It has been collected in brush-wood, swamps and bogs among *Sphagna*, moist hollows, open grasslands, mountain meadows, marshy plateaus, on bare rocks, and has even been recorded as growing in water; ascending to ca 3500 m alt.

Vern. *Si goeroe goeroe* (Sumatra).

5. *Burmattia coelestis* DON, Prod. Fl. Nep. (1825) 44; JONKER, Monogr. (1938) 120.—*B. javanica* BL. Enum. Fl. Jav. 1 (1827) 28.—*B. triflora* ROXB. Fl. Ind. 2 (1832) 117.—*B. azurea* GRIFF. Not. 3 (1851) 326.—*B. selebica* BECC. Malesia 1 (1877) 243.—*B. borneensis*, *B. chinensis*, *B. malaccensis* & *B. rigida* GANDOG. Bull. Soc. Bot. Fr. 66 (1919) 290.—Fig. 5.

Autotrophic annual, up to 30 cm. Stem simple or, sometimes, branched, bearing a single flower or a cluster of few flowers. Rosulate leaves linear or lanceolate, acute or acuminate, 3-nerved, about 1 cm by  $1\frac{1}{2}$ –3 mm. Stem leaves appressed, imbricate in the basal part, linear-lanceolate, subulate, rather long, up to 2 cm. Bracts lanceolate, acute, 4 by 1 mm. Flowers prominently 3-winged, blue, purplish or white, often with yellow lobes, about  $11\frac{1}{2}$  mm. Outer perianth lobes ovate, apiculate, with double margin, about  $1\frac{1}{2}$  mm. Inner ones lanceolate, apiculate, with double margin, about  $\frac{1}{2}$  mm. Tube cylindrical-trigonal, about 5 mm. Connective provided with 2 apical, divergent, obtuse to truncate crests and a basal hanging, rather long, obtuse spur. Style thick-filiform, bearing 3 sessile, funnel-shaped stigmas with swollen margin. Style with stigmas about 4 mm. Ovary ellipsoid to obovoid, truncate, attenuate towards the base, about 5 mm. Flower wings half elliptical to half obovate, about 10 by  $2\frac{1}{2}$  mm. Capsule obovoid, truncate, transversely dehiscent.

Distr. Widely spread in tropical Asia: India, Siam, Indo-China, S. China, and the Caroline Islands, in *Malaysia* throughout the Archipelago, in Java only in the W. part, once collected in the S. part of Madoera Island, and once in Bali, otherwise absent from the Lesser Sunda Islands.

Ecol. Grass-fields, among along-alang (*Imperata*), in mountain meadows, parks and plantations, ascending to ca 1700 m alt.

6. *Burmattia connata* JONKER, Monogr. (1938) 128.

Autotrophic annual, 15–30 cm. Stem simple, bearing 1–3, shortly pedicellate flowers. Rosulate leaves few, linear, acute or acuminate, 1-nerved, 4–8 by 1 mm. Stem leaves scale-like, appressed, linear, acute, 2–5 mm. Bracts linear-lanceolate, acute,  $1\frac{1}{2}$  mm. Flowers prominently 3-winged, 6–8 mm. Outer perianth lobes acute, with involute margin, 1 mm. Inner ones broadly ovate, obtuse, nearly  $\frac{1}{2}$  mm long. Perianth tube cylindrical, 3 mm. Connective rather broad, provided with 2 apical, divergent, obtuse crests. Thecae bright yellow, appressed against the connective and connate below the basal connective margin. Basal hanging spur lacking. Style as long as the tube, branching into 3 short branches, each bearing a peltate, disk-shaped stigma. Ovary ellipsoid to obconical,  $2\frac{1}{2}$ –4 mm. Flower wings half oblanceolate, decurrent along the pedicel, 8 by 2 mm. Capsule ellipsoid, dehiscent with transverse slits, 4–6 mm. Seeds scobiform, yellow.

Distr. *Malaysia*: Sumatra, Eastcoast Residency (Kota Pinang, Soengei Kana).

7. *Burmattia sphagnoides* BECC. Malesia 1 (1877) 246; JONKER, Monogr. (1938) 135.

Saprophyte,  $4\frac{1}{2}$ –12 cm. Stem simple, thick, beset with many lanceolate, acute, in the lower part imbricate, 3–6 mm long, scale-like leaves and bearing 2–5 subsessile flowers at the apex. Bracts broad-lanceolate to ovate, acute, 3–6 mm. Flowers 6-costate, white, about  $8\frac{1}{2}$  mm. Outer perianth lobes broadly triangular, with swollen margin, about  $8\frac{1}{2}$  mm. Inner ones fleshy, obtuse to rounded, papillose, almost 1 mm. Perianth tube cylindrical, about 2 mm. Connective oblong, acute at the base crowned by 2 divergent, obtuse crests. Style thick-filiform, bearing 3 sessile, obconical stigmas. Ovary large, broadly ellipsoid to subglobose, 4–5 mm.

Distr. *Malaysia*: Malay Peninsula, Sumatra (Eastcoast Res.), and Borneo (Sarawak).

Ecol. A rare species, occurring in decaying matter in forests.

8. *Burmattia bifaria* J.J.S. Icon. Bogor. 4 (1914) 379; JONKER, Monogr. (1938) 136.—*B. engganensis* JONKER, Blumea 3 (1938) 108; Monogr. (1938) 137.—Fig. 1.

Saprophyte, 5–13 cm. Stem simple or branched, beset with scale-like, ovate to lanceolate, 1-nerved, sometimes distichous, up to 5 mm long leaves and bearing 1 flower or branching into a bifid, up to 9-flowered cyme. Flowers shortly pedicellate, 6-costate, white or somewhat purplish, 9–13 mm. Limb fleshy. Outer perianth lobes triangular, obtuse, with involute, crenate margin,  $1\frac{1}{2}$ –2 mm. Inner ones ovate to orbicular,  $\frac{1}{4}$ – $1\frac{1}{2}$  mm. Perianth tube cylindrical-trigonal,  $2\frac{1}{2}$ –5 mm. Connective obtriangular, crowned by 2 divergent, papillose crests. Style thick-filiform, branching into 3 short branches, each bearing a somewhat funnel-shaped stigma with a broad, rotundate, membranous, hanging appendage. Style with stigmas 4– $4\frac{1}{2}$  mm. Ovary ellipsoid, 3–6 mm. Seeds ovoid, brown. Flower wings reduced to narrow, linear ribs.

Distr. *Malaysia*: West Java (vicinity of Buitenzorg) and Enggano Island (off SW. Sumatra).

Ecol. Among decaying leaves in forests, ascending to 1000 m alt.

9. *Burmattia championii* THW. Enum. Pl. Zeyl. (1864) 325; JONKER, Monogr. (1938) 138.—*B. tuberosa* BECC. Malesia 1 (1877) 245.—*B. capitata* (non MART.) MAKINO, Bot. Mag. Tok. 4 (1890) 23.—*B. japonica* MAXIM. ex MAK. Ill. Fl. Jap. 1, no 7 (1891) 4.—*B. dalzielii* RENDLE, Journ. Bot. 40 (1902) 311.—*B. chionantha* SCHLTR. Bot. Jahrb. 49 (1913) 107.—Fig. 6.

Saprophyte, 2–18 cm. Rhizome tuberous or elongate, covered with hair-like roots, producing small, adventitious tubers. Stem simple, beset with lanceolate, acute, appressed, scale-like,  $1\frac{1}{2}$ –4 mm long leaves. Bracts lanceolate, acute, about 3 mm. Flowers subsessile in a capitate inflorescence at the top of the stem, 3-costate, white, 5–12 mm. Outer perianth lobes triangular, acute, with involute margin in the upper part,  $1$ – $2\frac{1}{2}$  mm. Inner ones spatulate, rounded, slightly papillose at the margin, about  $\frac{3}{4}$  mm. Connective broadly oblong, obtuse at the base, crowned by 2 indistinct, divergent, obtuse crests and provided with a median small

point at the apex, usually directed inwards and then hardly perceptible. Style thick-filiform, bearing 3 subsessile funnel-shaped stigmas; style with stigmas 3 mm. Ovary ellipsoid to obovoid, 2–3 mm.



Fig. 9. *Burmannia lutescens* BECC., with broad wings (Mt Gedeh, W. Java),  $\times 1/1$ .

Distr. Ceylon, S. China, Japan and *Malaysia*: Batoe Islands (off W. Sumatra), Banka, W. Java, Borneo, and New Guinea.

Ecol. A species with a large ecological amplitude, occurring in humus of moist forests and also in parks, plantations, bamboo bush, on rocks in streams.

**10. *Burmannia micropetala* RIDL.** Trans. Linn. Soc. II, 9 (1916) 228; JONKER, Monogr. (1938) 140.

Saprophyte, 7½–15 cm. Stem simple, beset with acute or acuminate, 1-nerved, often keeled, 2–5 mm long, scale-like *leaves*. Bracts linear-lanceolate, acute, 1-nerved, about 4 mm. Pedicels up to 5 mm. *Flowers* shortly pedicellate, in contracted 3–8-flowered bifid or, sometimes, pseudo-umbellate cymes, very narrowly 3-winged to 3-costate, 7–9 mm. Outer perianth lobes triangular, acute,

about 2 mm, in the upper part provided with small, rounded, crenate lateral lobes. Inner ones broadly obovate, rounded, papillose at the margin, ½ mm. Perianth tube cylindrical, about 3 mm. Connective oblong, acute at the base, crowned by 2 divergent, acute crests. Style thick-filiform, branching at the apex into 3 very short branches, each bearing a funnel-shaped stigma with 2 small, apical points. Style with stigmas about 3 mm. Ovary ellipsoid, truncate, about 2½ mm.

Distr. *Malaysia*: New Guinea only.

**11. *Burmannia tridentata* BECC.** *Malesia* 1 (1877) 246; JONKER, Monogr. (1938) 141.

Saprophyte, 6–14 cm. Stem simple or branched, beset with appressed, lanceolate, acute, 1-veined, slightly keeled, scale-like, 1½–2 mm long *leaves*. Bracts ovate-lanceolate, acuminate, 1-veined, about 1½ mm. Stem or branches bearing 1–3, prominently winged, 2–7 mm long *flowers*. Outer perianth lobes triangular to ovate, obtuse, swollen at the margin, 1–1½ mm. Inner lobes absent. Perianth tube cylindrical, about 2 mm. Connective quadrangular with a broad, swollen, obtuse, hanging, basal spur, and an apical, erect, papillose, obtuse crest. Style as long as the tube, bearing 3 subsessile, funnel-shaped stigmas. Ovary subglobose, about 2 mm. Flower wings half elliptical to half-orbicular, about 4 by 2 mm. *Capsule* subglobose, about 2½ mm. Seeds scobiform.

Distr. *Malaysia*: Borneo, Sarawak (Mt Matang), once collected.

**12. *Burmannia oblonga* RIDL.** J. Str. Br. R. As. Soc. 41 (1904) 33; JONKER, Monogr. (1938) 25, 142.—*B. bifida* GAGNEP. Bull. Soc. Bot. Fr. 54 (1907) 462.

Saprophyte, 7–15 cm. Stem simple or branched, bearing 1–2 flowers, beset with appressed, ovate to lanceolate, obtuse, scale-like, about 1½ mm long *leaves*. Below the flower 2 lanceolate, scale-like bracts, 2½ mm. *Flowers* white, sometimes with yellow limb, 8–10 mm. Outer perianth lobes bifid, obtuse, about 1½ mm, papillose in the upper half at the margin, in the lower half with 2 yellow bags inside, provided with 2 involute, narrow triangular lateral lobes. Inner ones absent. Tube conical, 4–4½ mm long. Connective oblong, yellow, without crests or spur. Style thick-filiform, bearing at the apex 3 sessile, funnel-shaped curved stigmas. Style with stigmas about 4½ mm. Ovary subglobose, 2½–4 mm. Flower wings obovate, truncate, white, 5–7½ by 3–4 mm.

Distr. Hainan, Indo-China and *Malaysia*: Malay Peninsula, N. Sumatra (Atjeh and Eastcoast Res.).

Ecol. On forested rocks or loamy soil in dense jungle or forest, ascending to 1300 m.

**13. *Burmannia steenisii* JONKER,** Monogr. (1938) 158.

Delicate saprophyte, 2–6 cm. Stem simple or branched, bearing 1–2 flowers, beset with lanceolate, acute, scale-like, ½–1½ mm long *leaves*. Below each flower 1 or 2 lanceolate, 1-veined, acute bracts, about 1½ mm. *Flowers* pure white with yellow

limb, prominently 3-winged, 3–7 mm. Outer perianth lobes triangular, subobtusate, with swollen margin, about 1 mm. Inner ones orbiculate, minute. Perianth tube cylindrical-trigynous to conical-trigynous, about  $2\frac{1}{2}$  mm. Connective quadrangular, with a broad, obtuse, basal hanging spur and crowned by 2 short, thick, straight, obtuse, divergent crests. Style thick-filiform, bearing 3 sessile, slightly curved, bilabiate, funnel-shaped stigmas. Ovary subglobose, about 2 mm. Flower wings half elliptical to half-quadrangular, pure white, about  $4\frac{1}{2}$  by  $1\frac{1}{2}$  mm. *Capsule* subglobose, dehiscent with transverse slits. Seeds scobiform.

Distr. *Malaysia*: E. Java, Pasoeroean Residency (Mt Lamongan).

Ecol. Collected on the SW. slope of Mt Lamongan on coarse, volcanic sandy soil in brushwood, ca 600 m alt. It is the only species of the family hitherto reported from East Java.

**14. *Burmattia lutescens* BECC.** *Malesia* 1 (1877) 246; JONKER, *Monogr.* (1938) 24, 148.—*Gonianthes candida* BLUME, *Cat. Gew. Buitenzorg* (1823) 20.—*Gonyanthes candida* BLUME, *Flora* 8 (1825) 123.—*B. candida* (BL.) ENGL. *Nat. Pfl. Fam.* 2, 6 (1889) 50, not *B. candida* GRIFF. *ex* HOOK. *f.*—*B. gracilis* RIDL. *J. Str. Br. R. As. Soc.* 22 (1890) 335.—*B. papillosa* STAPF, *Trans. Linn. Soc. II*, 4 (1894) 232.—*B. novae-hiberniae* SCHLTR. in K. SCH. & LAUT. *Nachtr. Fl. D. Sch. Geb.* (1905) 73.—*B. gjellerupii* J.J.S. in FEDDE, *Rep.* 10 (1912) 487.—*B. gonyantha* HOCHR. *Candollea* 2 (1925) 325.—Fig. 9–10.

Saprophyte, up to 23 cm. Stem thickly filiform to robust, simple or branched, 1-flowered or forked into the inflorescence. *Leaves* lanceolate to ovate, acute, 1– $3\frac{1}{2}$  mm. Bracts lanceolate to ovate, often keeled and carinate. Cincinni bifid, up to 11-flowered; branches up to 3 cm. *Flowers* pedicellate, white, sometimes with yellow limb, seldom bluish, about  $8\frac{1}{2}$  mm. Outer perianth lobes ovate or triangular, apiculate, about  $1\frac{1}{2}$  mm; margin fleshy. Inner lobes minute, fleshy, orbiculate. Perianth tube trigynous,  $2\frac{1}{2}$ –5 mm. Connective truncate, rounded at the base, slightly 2-lobed at the apex into 2 very short, papillose crests. Basal spur absent. Style thick, bearing 3 subsessile, funnel-shaped to bowl-shaped stigmas. Style with stigmas as long as the tube. Ovary subglobose to truncate-globose, 3–5 mm. Flower wings various, linear, or elliptical, or rather broad, half-cuneate or quadrangular, running from the base of the limb to the middle or the base of the ovary. *Capsule* subglobose, dehiscent with large horizontal slits.

Distr. *Malaysia*: Sumatra, Malay Peninsula, Borneo, Java, New Guinea, and New Ireland.

Ecol. Usually in the humus of shady moist forests, up to 1500 m.

Notes. Specimens with narrow perianth wings have been described as *B. lutescens*, *B. novae-hiberniae*, *B. gjellerupii*, with elliptical ones as *Gonianthes candida*, and rather broad-winged speci-

mens as *B. gracilis*. They all belong to one species variable in that respect. In Java the species was often called *B. candida* (BL.) ENGL. but this is a later homonym; *B. candida* GRIFF. *ex* HOOK. *f.* is



Fig. 10. *Burmattia lutescens* BECC., Mt Salak, W. Java. Form with narrow perianth wings,  $\times \frac{2}{3}$ .

an allied species, occurring in Burma, Siam and the Langkawi Islands.

**15. *Burmattia malasica* JONKER, *Monogr.* (1938) 152.**—*Burmattia lutescens* (non BECC.) WINKLER, *Bot. Jahrb.* 48 (1913) 96.

Saprophyte,  $5\frac{1}{2}$ –8 cm. Stem simple, 1-flowered, seldom 2-flowered, beset with few appressed, lanceolate, subacute, 1-veined, slightly keeled,  $1\frac{1}{2}$ –2 mm long, scale-like leaves. Bracts elliptical, acuminate, 1-veined,  $1\frac{1}{2}$  mm. *Flowers* purple or white with yellow limb, prominently winged, about 5 mm. Outer perianth lobes triangular with swollen margin, acuminate to apiculate, about 1 mm. Inner lobes erect, lanceolate-ovate, obtuse, about  $\frac{1}{2}$  mm. Perianth tube cylindrical,  $1\frac{1}{2}$  mm. Connective obtriangular, obtuse at the base, provided with 2 short, divergent crests at the apex. Style cylindrical, bearing 3 sessile, funnel-shaped stigmas. Ovary subglobose to ellipsoid,  $2\frac{1}{2}$  by 2 mm. Flower wings half-orbiculate to half-elliptical, about 4 by 2 mm. *Capsule* ellipsoid to obovoid, dehiscent with a transverse slit. Seeds scobiform to fusiform.

Distr. S. Siam and *Malaysia*: SE. Borneo.

## 2. GYMNOSIPHON

BLUME, Enum. Pl. Jav. I (1827) 29; JONKER, Monogr. (1938) 27, 168.

Saprophytic annuals, without chlorophyll. *Leaves* scale-like. *Perianth* limb consisting of 6 lobes, the 3 outer being much larger and slightly 3-lobed. Anthers 3, sessile in the throat. Thecae bursting horizontally. Ovary ovoid to globose, 1-celled with 3 parietal placentas, each placenta provided with a large, globose gland at both sides of the top. Style filiform, branching into 3 short branches, each bearing a stigma. *Perianth* limb, stamens and the upper part of style with the stigmas caducous after flowering. *Capsule* crowned by the persistent perianth tube. Seeds ovoid to globose, reticulate.

Distr. 29 species, tropics of both hemispheres, not in Australia.

Notes. In Asia, and Malaysia, this genus is represented by the section *Eugymnosiphon* URBAN only, characterized by the reticulate-perforated capsule dehiscing at the top.

## KEY TO THE SPECIES

1. Anthers inserted above the middle of the perianth.
  2. Flowers pedicellate, in loose, many-flowered cincinni or bifid cincinni . . . . . 1. *G. aphyllus*
  2. Flowers  $\pm$  sessile in a 1- or sparsely flowered inflorescence.
    3. Capsule  $\pm$  globose. Margin lobes of the outer perianth lobes crenate . . . . . 2. *G. oliganthus*
    3. Capsule conical-ovoid. Margin lobes of the outer perianth lobes entire . . . . . 3. *G. minahassae*
1. Anthers inserted in or below the middle of the perianth.
  4. Anthers inserted below the middle of the perianth. Connective apiculate at the top. Ovary elongate-conical, tapering to the pedicel . . . . . 4. *G. affinis*
  4. Anthers inserted in the middle of the perianth. Connective not apiculate. Ovary marked from the pedicel.
    5. Flowers sessile or subsessile in loose cincinni or bifid cincinni . . . . . 5. *G. papuanus*
    5. Stem 1-2-flowered, or many sessile flowers in a capitate inflorescence at the top of the stem.
      6. Outer perianth lobes acuminate, a third of the length of the whole perianth. Connective narrow. Stigmas with dorsal crest. Inflorescence 2- to many-flowered . . . . . 6. *G. neglectus*
      6. Outer perianth lobes deltoid, short, a fifth of the whole perianth. Stigmas without crest. Inflorescence 1-3-flowered . . . . . 7. *G. pauciflorus*

1. *Gymnosiphon aphyllus* BLUME, Enum. Pl. Jav. 1 (1827) 29; JONKER, Monogr. (1938) 30, 170.—*G. borneense* BECC. Malesia 1 (1877) 241.—*G. pedicellatum* SCHLTR. Bot. Jahrb. 49 (1913) 105.—Fig. 7.

Stem up to 17 cm, forked into a bifid cincinnus or bearing a simple cincinnus. *Leaves* acute, often keeled, appressed, 1-2½ mm. Bracts ovate, obtuse, scale-like. Pedicels 1-5 mm. Inflorescence often loose and many-flowered. *Perianth* white or lilac; tubular part up to 4 mm; limb about 2½ mm. Outer perianth lobes ovate, obtuse, provided with a narrow, crenate lateral lobe at both sides. Inner ones linear-lanceolate, minute. Stigmas curved, funnel-shaped, inappendiculate. *Capsule* about 3 mm.

Distr. S. Siam, throughout Malaysia.

Ecol. On humus or decaying wood or leaves in the shade of moist forests, below 1500 m alt.

2. *Gymnosiphon oliganthus* SCHLTR. Bot. Jahrb. 49 (1913) 101; JONKER, Monogr. (1938) 172.

Stem tender, simple or branched, 4-9½ cm, 1- or 2-flowered. *Leaves* and bracts minute, to 1 mm, keeled and appressed. Pedicels up to 3 mm. *Flowers* white to bluish lilac, up to 5 mm. Outer perianth lobes triangular, subobtusely, provided with crenate lateral lobes. Inner ones small, cuneate, obtuse to truncate. Stigmas auriculate, soup-plate-shaped.

Distr. Malaysia: NE. Brit. New Guinea, once collected.

Ecol. In forests, 450 m alt.

3. *Gymnosiphon minahassae* SCHLTR. Bot. Jahrb. 49 (1913) 104; JONKER, Monogr. (1938) 172.

Stem usually simple, 2-5-flowered, 7-12 cm. *Leaves* acute, appressed, up to 1 mm. Bracts more or less obtuse, keeled. Pedicels 1-3 mm. *Perianth* white with bluish limb. Outer perianth lobes obtuse; lateral lobes entire. Inner ones lanceolate. *Perianth* limb deciduous above the anthers. Stigmas quadrangular, truncate at the apex, apiculate at the base.

Distr. Malaysia: N. Celebes (Minahasa), once collected.

Ecol. In humic soil, 800 m alt.

4. *Gymnosiphon affinis* J.J.S. Nova Guinea 8 (1909) 194; JONKER, Monogr. (1938) 31.—*G. torricellense* SCHLTR. Bot. Jahrb. 49 (1913) 101.

Stem 7-13 cm, simple or branched, white, lilac or rose-coloured, forked into a bifid cincinnus or bearing a simple cincinnus of 1-3 flowers. *Leaves* ovate, acuminate, 1-2 mm. Bracts to 3 mm. Pedicels 1-4 mm. *Perianth* white, limb 2½ mm, tube 1½ mm. Outer perianth lobes ovate, obtuse; lateral lobes crenate. Inner ones small, rather broad,

obovate, obtuse. Tube swollen at the insertion of the stamens. Connective quadrangular, acute-apiculate at the apex. Stigmas rather large, soup-plate-shaped. Ovary obconical, swollen in the upper part, about  $1\frac{1}{2}$  mm. *Capsule* thick-ellipsoid, about  $3\text{--}3\frac{1}{2}$  mm, crowned by the short, cylindrical to conical, 2 mm long, persistent part of the tube. Seeds brownish, fusiform, reticulate.

Distr. *Malaysia*: New Guinea.

Ecol. In forests, in humic soil, ascending to ca 700 m alt.

**5. *Gymnosiphon papuanus* BECC.** Malesia 1 (1877) 241; JONKER, Monogr. (1938) 174.—*G. celebicum* SCHLTR. Bot. Jahrb. 49 (1913) 104.

Stem simple or branched, 4–14 cm, colourless, bearing rather loose simple or bifid cymes of 3-many subsessile flowers. *Leaves* acuminate, up to  $2\frac{1}{2}$  mm. Bracts up to  $3\frac{1}{2}$  mm. *Perianth* whitish-purplish; limb about  $1\frac{1}{2}$  mm; tube up to  $4\frac{1}{2}$  mm. Outer perianth lobes ovate, triangular, obtuse; lateral lobes entire, involute. Inner ones small, linear. Connective deltoid, at the top 3-lobed, provided with a forked thickening. Stigmas rather large, soup-plate-shaped, obtuse, cordate, auriculate at the base. Ovary ovoid, about  $1\frac{1}{2}$  mm. *Capsule* obovoid to truncate-subglobose,  $2\frac{1}{2}\text{--}5$  mm long; crowned by the  $2\text{--}2\frac{1}{2}$  mm long, cylindrical persistent part of the tube.

Distr. Micronesia (Palau Islands), in *Malaysia*: Celebes and New Guinea.

Ecol. Moist forests, in humic soil, ascending to ca 500 m alt.

**6. *Gymnosiphon neglectus* JONKER,** Monogr. (1938) 175.

Stem simple or branched,  $7\frac{1}{2}\text{--}11$  cm, bearing 1 or few flowers or a capitate inflorescence, consisting of contracted cymes. *Leaves* lanceolate-ovate, acuminate, keeled,  $1\text{--}2\frac{1}{2}$  mm. Bracts to 5 mm. *Flowers* subsessile. *Perianth* dirty white; tube about 2 mm; limb about 2 mm. Outer perianth lobes ovate, acuminate; lateral lobes crenate. Inner ones small, linear, acute. Stigmas funnel-shaped, curved, dorsally cristate. Ovary ovoid, about 2 mm. *Capsule* nearly globose, crowned by the 2 mm long persistent part of the tube.

Distr. *Malaysia*: Java (Preanger Regencies and Semarang).

Ecol. Moist forests, ascending to 1000 m alt.

**7. *Gymnosiphon pauciflorus* SCHLTR.** Bot. Jahrb. 49 (1913) 102; JONKER, Monogr. (1938) 176.

Stem simple, colourless,  $2\frac{1}{2}\text{--}9\frac{1}{2}$  cm, bearing 1–3 sessile or subsessile flowers. *Leaves* ovate, acuminate,  $1\text{--}1\frac{1}{2}$  mm. Bracts to 3 mm. *Perianth* whitish to purplish; tube about 4 mm; limb very short. Outer perianth lobes ovate, acute, about  $1\text{--}1\frac{1}{2}$  mm; lateral lobes entire. Inner ones minute. Connective not apiculate, forked at the top. Style branches rather long, each bearing an ovoid, in transverse section somewhat triangular, stigma. Ovary obovoid, about 2 mm. *Capsule* ovoid, to  $3\frac{1}{2}$  mm; persistent part of the tube  $1\frac{1}{2}\text{--}2\frac{1}{2}$  mm.

Distr. *Malaysia*: New Guinea (Kani Mts), once collected.

### 3. THISMIA

GRIFFITH, Proc. Linn. Soc. 1 (1844) 221; JONKER, Monogr. (1938) 42, 227.

Saprophytic, fleshy herbs. Underground part in the Malaysian species coralliform or vermiform and creeping. Stems usually short, seldom branched. *Leaves* small, scale-like. Below the flowers 1 or more bracts, sometimes forming an involucre. Flowers actinomorphic or, sometimes, zygomorphic, urceolate to campanulate. *Perianth* lobes 6, occasionally free and of equal length and size, or inner ones larger, sometimes inner lobes connivent at the apex or connate in the apical part, then forming an erect mitre with 3 holes, in that case outer lobes very small. Stamens 3, free or, usually, stuck together to an anther tube, hanging at an annulus in the perianth throat. Filaments short, ribbon-shaped. Style thick, short, cylindrical or conical, persistent, bearing at its apex 3 simple or bilabiate stigmas. Ovary obconical or obovoid; the 3 placentas inserted at the bottom or parietally in the basal part of the ovary. *Fruit* fleshy, cup-shaped, crowned by the persistent, fleshy, basal ring of the perianth tube and the style with the stigmas.

Distr. 24 species, in tropical America (*Sect. Myostoma* and *Ophiomeris*), tropical Asia (*Sect. Euthismia* and *Sarcosiphon*), Chicago area, New Zealand and Tasmania (*Sect. Rodwaya*).

## KEY TO THE SPECIES

1. Inner perianth lobes free, spreading or erect. Underground part vermiform, creeping (SECT. *Euthismia* SCHLTR.)
2. Perianth lobes equal in length and size . . . . . (SUBSECT. *Odoardoia* SCHLTR.)
3. Flowers zygomorphic, geniculate . . . . . 1. *T. chrysops*
3. Flowers actinomorphic.
4. Stems several, flowers 4-6 in a raceme . . . . . 2. *T. racemosa*
4. Stem simple; flowers usually 1-3, terminal.
5. Leaves and bracts beset with distinct, prominent, blunt processes . . . . . 3. *T. grandiflora*
5. Leaves and bracts without processes.
6. Perianth lobes lanceolate, acute to acuminate, flat . . . . . 4. *T. fumida*
6. Perianth lobes triangular at the base, tapering into long, filiform tentacles.
7. Perianth tube with horizontal bars inside. Stigmas lanceolate.
8. Anthers provided with 3 thick-filiform appendages at the free apical margin. Perianth yellowish in the basal part, bright orange-yellow in the upper part and limb. Tentacles bright orange-red at the base. Perianth lobes with tentacles up to 10 mm . . . . . 5. *T. aseroe*
8. Anthers with 1 thick-filiform, median appendage and 2 lateral, short teeth at the free apical margin. Perianth white with 6 ochre-brown streaks; lobes with tentacles c. 20 mm 6. *T. alba*
7. Perianth tube without bars. Apical margin of the anthers with 2 teeth, each bearing a globose body at the top. Stigmas funnel-shaped with prominent margin . . . . . 7. *T. ophiuris*
2. Inner perianth lobes larger . . . . . (SUBSECT. *Brunonithismia* JONK.)
9. Perianth very zygomorphic, bilabiate. Upper lip fleshy, bent over the opening of the tube 8. *T. labiata*
9. Flowers actinomorphic.
10. Inner perianth lobes simple. Tube with prominent horizontal bars inside.
11. Anthers with 3 distinct teeth at the free apical margin, each tooth bearing a stiff hair. Outer perianth lobes broadly ovate, obtuse, erect . . . . . 9. *T. javanica*
11. Anthers slightly dentate apically. Outer perianth lobes short, ear-shaped . . . . . 10. *T. arachnites*
10. Inner perianth lobes consisting of 3 parts. Basal part erect, short, bearing the transverse part, hamate at the base and broadened at the apex. Third part awl-shaped, inserted on the broad apex of the second part. Perianth tube without bars . . . . . 11. *T. neptunis*
1. Inner perianth lobes connected at the apex to an erect mitre with 3 holes. Underground part coral-liform . . . . . (SECT. *Sarcosiphon* (BL.) JONK.)
12. Inner perianth lobes linear, connate at the tips, forming a mitre with large holes. Anthers ciliate in the basal part, toothed at the apex.
13. Apical margin of the anthers provided with 2 teeth, each bearing a stiff hair. Anthers slightly constricted in the middle, below the thecae . . . . . 12. *T. clandestina*
13. Apical margin of the anthers provided with 3 teeth, each bearing a stiff hair. Anthers constricted at the base, just above the thecae . . . . . 13. *T. episcopalis*
12. Inner perianth lobes spatulate, connate to a mitre with rather small holes. Anthers not ciliate, truncate at the apex . . . . . 14. *T. crocea*

1. *Thismia chrysops* RIDL. Ann. Bot. 9 (1895) 323; JONKER, Monogr. (1938) 237.

Stem usually simple and 1-flowered, about 15 cm. Leaves and bracts linear-lanceolate, acute more or less imbricate, up to 4 mm. Perianth tube geniculate; part below knee c. 3 mm, pink with longitudinal striae; the c. 5 mm long, upper part and limb chocolate-brown; perianth mouth yellow. Perianth lobes lanceolate, about 7 mm, tapering to filiform tentacles. Annulus prominent, slightly 6-lobed. Anthers quadrangular, provided with a thick hair on both sides of the free, apical margin and a broad, wing-like appendage, inserted on the midline of the connective. Stigmas oblong, bifid. Fruit stalk elongate.

Distr. *Malaysia*: Malay Peninsula (Malacca, Mt Ophir), once collected.

2. *Thismia racemosa* RIDL. J. Str. Br. R. As. Soc. 69 (1915) 13; JONKER, Monogr. (1938) 238.

Stems several, occasionally branched. Leaves linear, acuminate. Flowers 4-6 in a raceme; pedicels

1-1½ cm long. Perianth lobes short, triangular-ovate, blunt. Annulus prominent. Tube cylindrical, about 6 mm long.

Distr. *Malaysia*: Malay Peninsula (Pahang), once collected.

3. *Thismia grandiflora* RIDL. Ann. Bot. 9 (1895) 324; JONKER, Monogr. (1938) 239.

Stem simple, 1-flowered, 3 cm, provided with 2 basal, opposite, scale-like lanceolate leaves, about 5 mm, and 2 apical bracts, of the same shape and size as the basal leaves; both leaves and bracts beset with stiff, terete, blunt processes on the back. Perianth urceolate; tube pink with longitudinal striae, 8 mm. Lobes patent, ovate-triangular in the basal part, tapering at the apex to filiform tentacles. Annulus prominent. Anthers not or scarcely stuck together, provided with 2 lateral teeth at the free apical margin and a wing-like appendage inserted at the middle of the connective. Stigmas lanceolate, bifid, acute, papillose. Ovary about 4 mm, obovoid, truncate.



Distr. *Malaysia*: Malay Peninsula (Johore), once collected.

4. *Thismia fumida* RIDL. J. Str. Br. R. As. Soc. 22 (1890) 338; JONKER, Monogr. (1938) 240.

Stem slender, conspicuous, unbranched, about 10 cm, bearing 1-2 flowers. *Leaves* very small, appressed, lanceolate, acute. *Flowers* up to 1 cm. *Perianth* lobes lanceolate, acute, greenish-grey, constricted above the ovary and broadened below the limb, white with pink stripes. Annulus prominent. Ovary obconical. *Capsule* cup-shaped, ribbed and scabrid, crowned by the crenulate, basal ring of the perianth.

Distr. *Malaysia*: Malay Peninsula (Singapore and Selangor).

5. *Thismia aseroe* BECC. Malesia 1 (1877) 252; JONKER, Monogr. (1938) 240.—Fig. 3.

Stem simple or, sometimes, branched, 1- or 2-flowered, up to 8½ cm high. *Leaves* few, lanceolate, obtuse, to 4 mm long. At the base of the flowers an involucre, consisting of lanceolate bracts. *Perianth* obconic-campanulate, dirty-yellow in the basal part, bright orange-yellow in the upper part and in the limb. *Perianth* tube about 11 mm; the basal 5 mm inside with transverse bars. Lobes triangular, 3 mm long, ending in bright orange tentacles, red at the base, 6 mm long. Annulus prominent. Anthers with 3 short thick-filiform appendages at the free apical margin; in the lower part of the anther, inserted at the middle of the connective, a broad, dorsal quadrangular wing, wider than the anther. Thecae oblong, in the basal part of the anther; in the apical part 2 nectaries on the line of junction of one connective with the next. Ovary obovoid, 3 mm. Stigmas narrow-lanceolate, rather long, acute. *Capsule* ribbed, about 5 mm. Fruit stalk lengthening about 5-7 mm above the involucre. Seeds ellipsoid, ribbed.

Distr. *Malaysia*: Malay Peninsula (Singapore and Perak).

Ecol. In humid forests.

6. *Thismia alba* HOLTUM, *ms.*

A *Th. aseroe* differt antheris singulis munitis untantum appendice mediana crassi-filiformi, porro margine apicali libera instructa dentibus 2 laterilibus brevibus. Perianthium album signatum striis 6 longitudinalibus ochraceo-brunneis; perianthii lobis tentaculis ± 2 cm longis praeditis.

Stem simple, 1- to 3-flowered, up to 10 cm. *Leaves* few, 3-4½ mm long, lanceolate, acute or acuminate. At the base of the flowers an involucre, consisting of lanceolate, acute bracts. *Perianth* obconic-campanulate, white with 6 thin ochraceous-brown streaks, leading down from each perianth lobe, alternating with 6 thin yellow lines. *Perianth* tube about 10 mm, the basal part with transverse bars inside. Lobes triangular, 3-4 mm long, pale-yellow at the base, terminated by white, tentacles about 15 mm long. Annulus prominent, bright yellow. Anthers with 1 thick-filiform, median appendage and 2 lateral short teeth at the free apical margin; in the lower part of the anther, inserted

at the middle of the connective, a broad, dorsal, quadrangular wing, wider than the anther. Thecae oblong, in the basal part of the anther; in the apical part 2 nectaries on the line of junction of one connective with the next. Ovary semi-globose, about 2 mm. Stigmas lanceolate, retuse, papillose. *Capsule* obconical, about 6 mm.

Distr. *Malaysia*: Malay Peninsula (Pahang).

7. *Thismia ophiuris* BECC. Malesia 1 (1877) 252; JONKER, Monogr. (1938) 242.

Stem 2-6 mm, simple or branched, 1- or 2-flowered. *Leaves* lanceolate, obtuse, to 4 mm long. Below the flowers an involucre of several, lanceolate, 3-4 mm long and 1 mm wide bracts. *Perianth* urceolate, yellowish brown. Tube about 9 mm; lobes triangular, terminated by long, filiform tentacles, about 13 mm. Annulus broad and thick. Insertion of the stamens broad, then narrowed into a ribbon-shaped filament and again broadened into the quadrangular anthers. Apical free margin of the anthers provided with 2 teeth, each with a globose body at the top. Ovary ovoid, about 5 mm. Style bearing 3 sessile, funnel-shaped, circumvalled stigmas. *Capsule* ribbed; seeds oblong with longitudinal ribs; funicles about the same length as the seeds.

Distr. *Malaysia*: Borneo (Sarawak & Br. N. Borneo).

8. *Thismia labiata* J.J.S. Bull. Jard. Bot. Btzg III, 9 (1927) 220; JONKER, Monogr. (1938) 44, 243.

Stem simple, 22 mm long. *Leaves* ovate, acute, appressed, 1½ mm. Flowers with an involucre of 3 ovate-lanceolate, acute, 5½ mm long bracts. *Perianth* urceolate in the basal part, bilabiate-zygomorphous in the upper part. Outer perianth lobes 2½ mm, broad-ovate at the base, rounded, with a subulate appendage inserted below the top. Inner lobes linear to filiform, subulate, 5 mm. A thick, fleshy upper lip bent over the perianth mouth; on the back of the upper lip 1 inner and 2 outer perianth lobes. The other 2 inner lobes between the 2 lips. The third outer lobe inserted on the middle of the lower lip. Stamens rounded and ciliate at the free, apical margin; thecae elongate; outer side of the stamen provided with scattered hairs. The 3 stigmas connate to a capitate, 3-lobed stigma. Ovary obconical.

Distr. *Malaysia*: Sumatra (Eastcoast Res.) once collected.

9. *Thismia javanica* J.J.S. Ann. Jard. Bot. Btzg 23 (1910) 32; JONKER, Monogr. (1938) 245.—Fig. 11.

Stem simple or branched, up to 12 cm, 1- to 5-flowered. *Leaves* ovate or lanceolate-ovate, obtuse, 3 mm. At the base of a flower an involucre of 3 bracts. *Perianth* tube 7 mm, urceolate, whitish with 12 longitudinal, orange stripes, inside with longitudinal bars connected by many transverse bars. Outer perianth lobes obtuse, ovate; inner ones triangular, terminated in up to 3 cm long, filiform tentacles. Anthers 3-toothed at the free apical margin; each tooth terminating in a hair. On the outer side of the anther, inserted in the middle, a qua-



drangular appendage, wider than the stamen. Margin of the appendage strigose. Style orange-coloured; stigmas sessile, ovate, truncate. Ovary obovoid, 3 mm. *Capsule* orange-coloured, about 6 mm. Seeds ellipsoid.

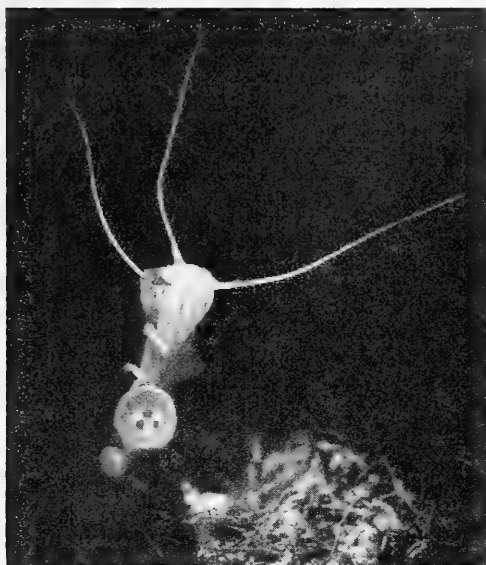


Fig. 11. *Thismia javanica* J. J. S. Doengoes Iwoel,  $\times \frac{3}{2}$ . (LIEFTINCK)

Distr. *Malaysia*: Sumatra and W. Java.

Ecol. Shade of forests, on humus, below 1000 m alt.

Vern. *Angkreng rambut* (Java).

Notes. Perhaps conspecific with the following species.

10. *Thismia arachnites* RIDL. Journ. Str. Br. Roy. As. Soc. 44(1905) 197; JONKER, Monogr. (1938) 247.

Stems simple, 1–7½ cm, bearing 1–3 flowers. *Leaves* few, lanceolate, acute, about 5 mm. At the base of the flowers an involucre, consisting of ovate-lanceolate, acute, 5–7 mm long bracts. *Perianth* urceolate to obconical, about 8 mm long, inside with longitudinal bars, connected by many transverse bars; tube transparent, white with 6, vertical, red streaks in the apical part. *Perianth* lobes pale red. Outer lobes very short, about ½ mm, ear-shaped; inner ones triangular, about 1 mm, terminating in up to 3 cm long, thin, filiform tentacles. Annulus prominent, yellow. Anthers slightly 3-toothed at the apical free margin, the lateral teeth somewhat larger than the median one, each tooth terminating in an indistinct, very thin, fragile hair. On the outer side of the anther, inserted in the middle, a quadrangular strigose appendage, wider than the stamen. Style thick, conical; stigmas lanceolate, obtuse. Fruit stalk lengthening above the involucre.

Distr. *Malaysia*: Malay Peninsula (Perak & Pahang).

Note. Closely related to the preceding species, perhaps conspecific.

11. *Thismia neptunis* BECC. *Malesia* I (1877) 251; JONKER, Monogr. (1938) 43, 243.

Stem 4–25 mm, simple, 1-flowered, beset with few, lanceolate, acute, about 3 mm long *leaves*. At the base of the flower an involucre of 3 lanceolate, acute, 4–6 mm long bracts. *Perianth* tube urceolate, with 6 longitudinal stripes, 6 mm. Outer perianth lobes simple, recurved, filiform with triangular base, 4½ mm. Inner ones erect, about 15 mm, consisting of an erect, short, basal part; a transverse part with hamate base and a broadened, rounded apex and, inserted on the apex of the transverse part, an erect, long, awl-shaped part. Annulus prominent. Anther quadrangular, 3-toothed at the free apical margin. Stigmas lanceolate, acute. Ovary obovoid, truncate, 1½ mm.

Distr. *Malaysia*: Borneo (Sarawak, Mt Mat-tang), once collected.

12. *Thismia clandestina* (BL.) MIQ. Fl. Ind. Bat. 3 (1855) 616; JONKER, Monogr. (1938) 252.—*Sarcosiphon clandestinus* BL. Mus. Bot. Lugd. Bat. 1 (1849) 65.

Stem up to 5 cm, 1–2-flowered. *Leaves* appressed, acuminate, to 5 mm. At the base of the flower 3 bracts. *Perianth* tube urceolate, about 2½ mm, greenish-grey, with 12 longitudinal, brownish-black stripes. Outer perianth lobes almost absent, inner ones connate to a 2½ mm long, acuminate mitre. Annulus prominent, 6-lobed. Margin of the filaments and upper part of the anthers with short hairs. Thecae oblong, inserted on the margins of the anthers. Free apical margin of the anthers with 2 teeth, tapering to stiff hairs. Inserted on the midline a large, wing-like appendage, provided with bundles of hairs on the angles. Stigmas ovate, bilobate, papillose, whitish. Ovary obovoid, about 3 mm. Funicle about the same length as the ovules. *Capsule* papillose, about 5 mm.

Distr. *Malaysia*: W. Java.

Ecol. In humus of forests, ascending to ca 1000 m alt.

13. *Thismia episcopolis* (BECC.) F. v. MUELL. Pap. & Proc. R. Soc. Tas. for 1890(1891) 235; JONKER, Monogr. (1938) 46, 253.—*Geomitra episcopolis* BECC. *Malesia* I (1877) 250.—*Bagnisia episcopolis* ENGL. Pf. Fam. 2, 6 (1889) 48.—*Sarcosiphon episcopolis* SCHTR. Notizbl. 8 (1921) 38.—Fig. 4.

Stem simple or branched, 1–8 flowered, up to 19 cm. *Leaves* appressed, ovate, acute, 2–5 mm. *Perianth* tube urceolate, yellow with black stripes, 6–9 mm. Outer perianth lobes almost lacking; inner connate to a slightly acuminate, about 5 mm long mitre. Filaments constricted. Thecae divergent. Margin of the anthers and the winglike appendage hairy, apical part of the anther, below the insertion of the appendage, darker coloured; free apical margin 3-toothed, each tooth terminated by a stiff hair. Stigmas bilobate. Ovary obovoid, 3 mm. Funicles about as long as the ovules. *Capsule* ribbed, about 3 mm. Fruit stalk lengthened.

Distr. *Malaysia*: Borneo (Sarawak, Br. N. Borneo).

Ecol. In humus of forests, ascending to ca 1700 m alt.

**14. *Thismia crocea* (BECC.) J.J.S.** Nova Guinea 8, 1 (1909) 193; JONKER, Monogr. (1938) 44, 251. —*Bagnisia crocea* BECC. Malesia 1 (1877) 249. —*Thismia versteegii* J.J.S. Nova Guinea 8, 1 (1909) 193. —*Sarcosiphon croceus* SCHLTR. Notizbl. 8 (1921) 38. —*Sarcosiphon versteegii* SCHLTR. Notizbl. 8 (1921) 38.

Stem simple, 1–3-flowered, about 6 cm. *Leaves* appressed in the basal part, lanceolate, acute, to 6 mm. At the base of the flowers 3 ovate lanceolate, acute bracts. *Perianth* tube urceolate, ribbed, reddish-brown in the upper part, yellowish-orange in the middle and white at the base, about 6 mm.

Outer *perianth* lobes broad, short, rounded; inner ones connate to a thick, 2 mm long mitre with 3 narrow holes and 3 prominent midribs. Annulus slightly 12-lobed. Anthers quadrangular, not hairy; thecae oblong, parallel; inserted in the apical part of the anther a broad appendage with curled margins. Stigmas ovate, obtuse, papillose. Ovary light reddish-brown, about 2 mm. Funicles as long as the ovules. *Fruit* ribbed, obovoid. Fruit stalk thickened and lengthened after flowering to 16 mm above the bracts.

Distr. *Malaysia*: West New Guinea.

Notes. In Perak (Malay Peninsula), RIDLEY observed a *Thismia*, described by him in Mat. Fl. Mal. Pen. 2 (1907) 75, as *Bagnisia crocea* var. *brunnea*. This specimen was apparently not preserved; it is highly improbable that it belongs to *T. crocea*.

#### 4. GEOMITRA

BECCARI, Malesia 1 (1877) 250; JONKER, Monogr. (1938) 46, 254.

Underground part unknown. Stem beset with scale-like *leaves*. *Flowers* rather large, with an involucre at the base. Tubular part of the *perianth* urceolate. Outer *perianth* lobes free, very small. Inner ones connate at the top to an erect mitre with 3 holes, crowned by 3 apical, long, thick-filiform, erect, clavately swollen appendages. Basal ring of the *perianth* tube thickened, persistent on the fruit. Throat margin of the *perianth* thickened to a 6-lobed annulus. Stamens 6, hanging at the annulus; anthers stuck together to a tube. Style short, cylindrical, fleshy, bearing 3 erect stigmas. Ovary with 3 stalked placentas; funicles short. *Capsule* cup-shaped, crowned by the persistent, basal *perianth* ring and the style.

Distr. One species, known only from Borneo (Sarawak).

**1. *Geomitra clavigera* BECC.** Malesia 1 (1877) 251; JONKER, Monogr. (1938) 46, 255. —*Thismia clavigera* F. v. MUELL. Vict. Nat. (1890) 235. —*Sarcosiphon clavigerus* SCHLTR. Notizbl. 8 (1921) 39.

Stem simple, up to 12 cm, bearing about 3 flowers. *Leaves* lanceolate, acuminate or acute, 2–6 mm. Bracts lanceolate, acuminate, 6–7 mm. *Perianth* tube about 9 mm. Outer *perianth* lobes erect, broadly triangular, about 1 mm. Mitre about

3–5 mm, hooked at the apex. Filiform appendages 8–12 mm long. Anthers quadrangular; free apical margin with 3 teeth, each bearing a stiff, transparent hair. Anther tube about 4 mm. Stigmas lanceolate, bilobate; lobes acute. Ovary obovoid, truncate, about 3 mm.

Distr. *Malaysia*: Borneo (Sarawak), once collected.

#### 5. SCAPHIOPHORA

SCHLTR. Notizbl. 8 (1921) 39; JONKER, Monogr. (1938) 46, 256.

Roots coralliform. Stem provided with scale-like *leaves*; at the base of the flower an involucre. *Perianth* tube urceolate. Outer *perianth* lobes small; inner ones narrow in the basal part, broadened at the apical part, connate to an erect mitre with 3 holes in the basal part. Mitre crowned by a long, stiff column, bearing at the top 3 lobes. Stamens 6, hanging, inserted at an annulus in the *perianth* throat. Filaments ribbon-shaped. Anthers stuck together to an anther tube; each anther provided with a wing-like appendage, inserted in the middle and broader than the anther. Placentas stalked; stalks inserted peripherically at the bottom of the ovary. Basal *perianth* ring and style persistent on the *fruit*.

Distr. Two species, one in New Guinea, the other in the Philippines.

## KEY TO THE SPECIES

1. Flowers 3–6½ cm long (without column). Column 1½–6 cm long, at the apex broadened to 3 fleshy, connate lobes . . . . . **1. *S. gigantea***  
 1. Flowers 1 cm long (without column). Column 5 mm long, bearing at the apex 3 cup-shaped bodies . . . . . **2. *S. appendiculata***

**1. *Scaphiophora gigantea* JONKER, Monogr. (1938) 257.—Fig. 2.**

Stem 4–10½ cm, partly subterranean. *Leaves* lanceolate, acute, 2–4 mm, the lower ones keeled. Bracts ovate, lanceolate, acute, about 18 mm. *Perianth* tube 15–21 mm, pale rose-coloured with yellow veins, reticulate below the inner perianth lobes. Outer perianth lobes ear-shaped. Mitre 5–9 mm long, orange to yolk-yellow. Stamens about 7 mm. Anthers prominently nerved; free apical margin provided with 3 median and 2 lateral teeth; each bearing a stiff, transparent hair. Appendix of the anther greenish-blue; lateral margins bearing 3 bundles of short hairs; apical margin pilose. Thecae divergent, ovate. Style truncate-conical. Stigmas sessile, obovate, 2-lobed, papillose outside and in the upper part inside. *Fruit* cup-shaped. Placentas connate at the apex, stalked; stalks about the same length as the placentas.

Distr. *Malaysia*: Philippines (Luzon), twice collected.

**2. *Scaphiophora appendiculata* (SCHLTR.) SCHLTR. Notizbl. 8 (1921) 39; JONKER, Monogr. (1938) 259. —*Thismia appendiculata* SCHLTR. Bot. Jahrb. 55 (1918) 202.**

Stem 15–20 mm high, partly subterranean, usually 1-flowered. *Leaves* ovate to lanceolate, 2–3 mm. Bracts lanceolate, acute, about 5 mm. *Perianth* tube 6 mm, yellowish white in the lower part. Outer perianth lobes small, ear-shaped. Mitre 3–6 mm, orange-coloured. At the base of each perianth lobe, on the inner side, a glandular, bowl-shaped body. Column ± broadened towards the apex, bearing 3 thick, fleshy, cup-shaped bodies. Stamens about 3 mm. Appendage of the anther crenulate at the apical margin. Thecae divergent. Style truncate-conical, 1½ mm. Stigmas sessile, obovate, 2-lobed, 1 mm. Ovary 3½ mm. Placentas stalked, above the fertile part suddenly narrowed again into a filiform, apical appendage. Placentas attached to the bottom of the ovary by the stalks and to the roof by the apical appendages.

Distr. *Malaysia*: Northeast New Guinea, once collected.

## SPHENOCLEACEAE (H. K. Airy Shaw, Kew)

MART. ex LINDL. Nat. Syst. ed. 2 (1836) 238; DC. Prod. 8 (1939) 548; WIGHT, Ill. Ind. bot. 2 (1850) 115; MIQ. Fl. Ind. Bat. 2 (1857) 569; BOISS. Fl. Or. 3 (1875) 963.

Annual (?) laticiferous herbs, with the habit of *Phytolacca*. Stem erect, somewhat succulent. *Leaves* spirally arranged, simple, entire, exstipulate. Inflorescences terminal, densely spicate, acropetal. *Flowers* subtended by a bract and two bracteoles, bisexual, actinomorphic. Calyx tube adnate to the ovary; segments 5, united below, imbricate, connivent, persistent. Corolla campanulate-urceolate, perigynous; lobes 5, imbricate. Stamens 5, epipetalous, alternating with the corolla lobes; filaments short; anthers rounded, 2-locular, dehiscing longitudinally. Ovary semi-inferior, 2-locular; style short, stigma capitate; ovules  $\infty$ , attached to large spongy stipitate axile placentas. *Capsule* cuneate-obconic, 2-locular, membranous, circumscissile; seeds  $\infty$ , minute, oblong, rugose-costate, albumen very scanty or none (?); embryo axile, straight, subterete.

Distr. Mono-generic, almost pantropical.

Ecol., Uses, Vern., see below under *S. zeylanica*.

Notes. The maintenance of *Sphenocleaceae* as a separate family is abundantly justified; there is no evidence of affinity with *Campanulaceae*, with which it has hitherto been associated. The habit resembles that of *Phytolacca*, and the anatomy shows several significant features occurring in members of the *Phytolaccaceae* and related families. Other characters suggest *Primulaceae*, and provisionally it is suggested that the family represents a 'half-way house' between the families mentioned. From the *Centrospermae* it deviates in the semi-inferior ovary, gamopetalous corolla and straight embryo, and from the *Primulaceae* principally in the alternipetalous stamens. A separate note on the classification will be published in the Kew Bulletin.

### 1. SPHENOCLEA

GAERTN. Fruct. 1 (1788) 113, t. 24, f. 5; MIQ. Fl. Ind. Bat. 2 (1857) 569; B. & H. Gen. Pl. 2 (1876) 560; BAILL. Hist. Pl. 8 (1886) 327, 362, f. 158-161; SCHÖNLAND, in E. & P. 4, 5 (1889) 60; BOERL. Handl. 2, 1 (1891) 257. For characters see family description.

Distr. Two species, one pantropical, one endemic in W. Africa.

1. *S. zeylanica* GAERTN. Fruct. *l.c.*; Bl. Bijdr. 16 (1826) 1138; MORITZI, Syst. Verz. (1845-6) 66; BLANCO, Fl. Filip. ed. 2 (1845) 62, ed. 3, 1 (1877) 117, t. 143; MIQ. *l.c.*; F.-VILL. Nov. App. (1880) 121; K. & G. Mat. Fl. Mal. Pen. no 16 (1905) 57; KOORD. Exk. Fl. 3 (1912) 301; MERR. Fl. Man. (1912) 462; Sp. Blanc. (1918) 374; En. Philip. 3 (1923) 588; RIDL. Fl. Mal. Pen. 2 (1923) 204; BACKER, Onkruidfl. Jav. Suik. (1931) 742; OCHSE & BAKH. v. d. Br. Veg. D. E. I. (1931) 93, f. 55, 349.—*Pongatium spongiosum* BLANCO, Fl. Filip. (1837) 86.—*Reichelia palustris* BLANCO, *l.c.* 220; ed. 2 (1845) 155; ed. 3, 1 (1877) 277, t. 143.—Fig. 1.

Roots long, cord-like. Stem hollow, 7-150 cm. *Leaves* oblong to lanceolate-oblong, attenuate at both ends, acute or obtuse, glabrous,  $2\frac{1}{2}$ -12 $\frac{1}{2}$  by  $\frac{1}{2}$ -5 cm; petiole 3-30 mm. Spikes  $\frac{3}{4}$ -7 $\frac{1}{2}$  cm long, cylindric; peduncle 1-8 cm. Bracts and bracteoles  $\pm$  spatulate, the green apices arched over the calyx before and after anthesis. *Flowers* crowded, rhomboid or hexagonal by compression, sessile, wedge-shaped below, attached longitudinally to the rachis by a linear base. Calyx segments deltoid-semicircular, obtuse, ultimately accrescent and con-

nivent. Corolla whitish,  $2\frac{1}{2}$ -4 mm long, caducous, segments ovate-triangular, obtuse or acute, united slightly more than half-way, connivent. Stamens inserted half-way up tube of corolla, filaments slightly dilated at base. Ovary obovoid,  $2\frac{1}{2}$  mm long, apex broad, free, truncate. *Capsule* 4-5 mm in diam., dehiscing below the calyx segments which fall with the lid, leaving the scarious persistent base. Seeds yellowish-brown,  $\pm \frac{1}{2}$  mm long.

Distr. Trop. America (introduced), trop. Africa (incl. Madagascar) (indigenous; cf. BENTH. in Journ. Linn. Soc. Bot. 15 (1875) 13), SW. Persia to Turkestan, India and Formosa (prob. introduced), in Malaysia (prob. introduced): Malay Peninsula (scarce, mainly in the prov. Kedah and Wellesley), ?Sumatra, Philippines (Luzon, Biliran, Negros), Java, Bali, SW. Celebes and Timor.

Ecol. A weedy annual occurring in almost any kind of damp ground at low alt. up to 350 m: river banks and dry riverbeds, damp marshy or periodically inundated depressions, seasonal swamps, sides of ponds, ditches, and stagnant water generally, especially rice-fields, both in continuously rainy and in seasonal climates. Almost every flower on

every inflor. sets fruit; only one or two flowers are open at once on any one head. In Malaysia never gregarious, nor growing on mud of tidal creeks, as in Africa.

Uses. In Java young plants and tips of older plants are steamed and eaten with rice; they have a slightly bitter taste; leaves are sold under the name *goenda padi*.

Vern. Java: *goenda*, M, J, Sd, *g. rawah*, *g. lalab*, *g. padi*, *g. sapi*, Sd, *goendha*, Md, *gondo*, J; Bali: *gonda*; Celebes: *gangang karaèng*, Mk., *gonra*, Mk, Bg; Philippines: *mais-mais* (Panay, Bisaya), *silisi-*

*lihan* (Tagalog); the Javanese names are also applied to the superficially similar Hydrophyllaceous *Hydrolea zeylanica* (L.) VAHL.

Notes. The plant is described as laticiferous but METCALFE reports that 'typical laticiferous canals are absent from the phloem, although occasional elongated cells have been observed in this tissue with granular contents which may represent coagulated latex'. Miss M. C. VREEDE, Anatomist in the Treub Lab., Buitenzorg, Java, reported, July 6, 1948, that in fresh material she could find neither milky juice nor laticiferous elements.



Fig. 1. *Spnenoclea zeylanica* GAERTN.  $\times \frac{1}{4}$ . A rich-flowering individual.

## NYSSACEAE<sup>1</sup> (J. Wasscher, Groningen)

### 1. NYSSA

LINNÉ, Sp. Pl. (1753) 1058; Gen. Pl. ed. 5 (1754) 478; WASSCHER, Blumea 1 (1935) 343.—*Agathisanthes* & *Ceratostachys* Bl. Bijdr. (1825) 644; MIQ. Fl. Ind. Bat. 1, 1 (1856) 838.—*Agathidanthus* HASSK. Cat. Hort. Bog. (1844) 254.—*Daphniphyllopsis* KURZ, J. As. Soc. Beng. 44, II (1875) 201.

Diocious trees or shrubs. *Leaves* simple, scattered. Stipules 0. *Flowers* unisexual, often in heads, in the axils of a bract and with 2 bracteoles. ♂: in axillary heads or short racemes; calyx entire or 5-toothed; petals 5, imbricate, often small, alternate with the calyx; stamens 8–16 in 2 alternating whorls; anthers small, dorsifixed with lateral lengthwise slits; disk pulvinate; style rudimentary. ♀: solitary, axillary or in 2–10-flowered heads; ovary inferior, 1-locular, connate with the 5-toothed or entire calyx; petals 5–8 often minute; stamens of inner whorl partly sterile, both petals and anthers soon dropping; style with 2 appressed later divergent often torulose branches stigmatose on their inside, brittle, often deficient in the herbarium. Ovule 1, hanging from the apex of the cell, anatropous with 2 integuments. *Fruit* drupaceous ovoid to oblong.

Distr. *Ca* 6 spp., 4 in Atlantic N. America, 1 in China, 1 from India to W. Malaysia.

Ecol. The American spp. mostly in swamp forests, the Asiatic one not so.

Notes. The flowers are often deficient in the herbaria. The polymorphy of *N. javanica* suggests that perhaps more than one species is present in Malaysia.

**1. *Nyssa javanica* (BL.) WANG.** Pfl. R. 41 (1909) 15; WASSCHER, Blumea 1 (1935) 344.—*Ceratostachys arborea* BL. Bijdr. (1825) 644; MIQ. Fl. Ind. Bat. 1, 1 (1856) 839.—*Agathisanthes javanica* BL. Bijdr. (1825) 645; MIQ. Fl. Ind. Bat. 1, 1 (1856) 839.—*Agathidanthus javanica* HASSK. Cat. Hort. Bog. (1844) 254.—*Nyssa sessiliflora* HOOK. f. & Th. Gen. Pl. 1 (1867) 952.—*Ilex daphniphyllodes* KURZ, J. As. Soc. Beng. 39, II (1870) 72.—*Daphniphyllopsis capitata* KURZ, Lc. 44, II (1875) 201; For. Fl. Burm. 1 (1877) 240.—*Nyssa arborea* KOORD. Exk. Fl. Jav. 2 (1912) 731.—*Nyssa bifida* CRAIB, Kew Bull. (1913) 69.—**Fig. 1.**

Diocious tree up to 40 m, 30–100 cm diam., clear bole 13–23 m, buttresses mostly absent. Twigs tomentose, glabrescent. *Leaves* rather densely set, oblong-lanceolate to obovate, rarely subovate, base acute, apex abruptly acuminate, coriaceous, entire, sparsely hairy to tomentose on midrib and nerves beneath, further glabrous, 5–23 by 2½–8 cm; in seedlings the 1st pair of leaves is opposite; nerves 8–11 pairs; petiole 1–3½ cm long, flat or slightly sulcate, hairy or glabrous. *Flowers* pallid, in pedunculate nearly globose axillary heads 12–18 mm diameter; peduncles flattened towards the apex ¾–5 cm long, their apex 2–5 mm broad, glabrous or hairy, ca halfway with 1–2 sessile small acute bracts 3–4 by 1 mm. Receptacle globose to ellipsoid, flattened, 2–3 and 4–5 mm. Flowers enveloped by 1 bract and 2 half-way connate bracteoles, all broad-ovate, sericeous-ciliate, 2–2½ by 1½–3 mm, in ♀ persistent.—♂:

Flowers 20–40 capitate, ½–4 mm pedicellate; calyx teeth 4–5 rounded, ½–¾ by 1–1½ mm, outside appressed-hairy, ciliate; petals 4–5 free, ovate with broad base, curled back, 3–5 by 1½–3 mm, both sides very short spreading hairy; stamens 8–10, those of outer whorl 3–5 of inner 2–4 mm long; anthers elliptic 1½ by 1 mm, outer loculi often larger than inner ones; disk ½–1 by 1–2 mm, 8–10 lobed.—♀: Flowers usually 3–8 rarely up to 18, sessile; calyx campanulate 2–3 by 1½ mm, densely appressed-sericeous; lobes 4–5 irregular, rounded, ½–1 by 2½ mm or almost absent; petals 4–5 as in ♂ but smaller 3–4 by 2½–3 mm; stamens 8–10, probably of inner whorl at least sterile, smaller than in ♂; style 1½–2 by ½–1 mm, with 2 divergent (in bud one branch longer and incurved over the other), or curled branches 1–2 mm long. *Fruit* ellipsoidal, little flattened, 1½–2¼ by 4–1½ cm, ¾–1½ cm thick, crowned by the disk & calyx limb 1 by 2 mm, immature yellow, ripe purple. Exocarp coriaceous glabrescent, mesocarp spongy-fleshy. Stone flattened obovate, acute 1–2 by ½–1¼ cm, 2–6 mm thick, on one side with 5 length-grooves, the other side with few tubercles above the middle and a length-keel.

Distr. SE. Asia and Malaysia: Sumatra, Mal. Peninsula, Borneo, Java, 600–1600 m alt. (in Siam and Sumatra once at 100 m, in the Himalaya ascending to 2400 m acc. to Hook. f.).

Ecol. Common or scarce, never gregarious, in mixed evergreen mountain forests both in ever-wet and periodically dry regions (E. Java), not in sec-

(1) The family consists of 3 genera, 2 of which are endemic in Central Asia. *Nyssa* occurs from Malaysia to Asia and N. America. Formerly the family was included in the *Cornaceae sens. ampl.*



Fig. 1. *Nyssa javanica* (BL.) WANG. Twig,  $\times \frac{2}{3}$ , a. male flower,  $\times 6$ , b-d. female flowers,  $\times 6$ , e. galled fruit,  $\times \frac{2}{3}$ , f. fruit,  $\times \frac{2}{3}$ , g. seed,  $\times \frac{2}{3}$ .

ondary forest, mostly *fl.* Jan.–May, *fr.* July–Dec. The thick end-bud produces young pale brown-red foliage and flowers in the rainy season. Fruits often deformed into worm-shaped galls.

Vern. Malay names in Sumatra mostly ‘*medang*’ with some additional name (also common for *Laur.*), in Java *hiroeng*, or *kiroeng*, Sd; Javanese names very variable.

Uses: Rather heavy dense wood not highly estimated. Bark grey, smooth, dingy yellow in section. Fruits are said to be edible and have a sweet odour, but a bitter acid taste.

Notes. The fruits are often deformed to a gall on which BLUME based his *Ceratostachys arborea*. The variability in the flowering parts, their early dropping, and the brittleness of the flowers in the herbarium have caused many discrepancies in literature.

#### Excluded

*Nyssa hollrungii* K. SCH. Nachtr. Fl. D. Schutzgeb Süds. (1905) 334 = *Alangium javanicum* (Bl.) WANG. var. *papuanum* (MANSF. & MELCH.) BLOEMB. Blumea 1 (1935) 284.



## SARCOSPERMACEAE (H. J. Lam, Leyden)

### 1. SARCOSPERMA

HOOK. *f.* in B. & H. Gen. Pl. 2 (1876) 655; RIDL. Fl. Mal. Pen. 2 (1923) 260; H. J. LAM, Bull. J. B. B. III, 7 (1925) 248; *l.c.* 8 (1926) 18; Philip. J. Sc. 49 (1932) 143; Blumea 3 (1938) 183; *l.c.* 3 (1939) 261; *l.c.* 4 (1941) 322.—*Bracea* KING, J. As. Soc. Beng. 64, II (1896) 101.—*Apoia* MERR. Philip. J. Sc. 17 (1920) 605.

Trees or shrubs, at least two *spp.* laticiferous. *Leaves* simple, entire, subopposite or opposite, rarely subverticillate; often with some alternate ones between, penninerved; petiole sometimes with auricles at the top; blade often with glandular pits in the axils of the secondary nerves or scattered on the undersurface; tertiary nerves slender but conspicuous, transverse and usually crowded, more or less perpendicular to the midrib. Stipules small, caducous. *Flowers* bisexual, in small fascicles or solitary, placed along racemose or more or less broadly paniculate axillary shoots; bracts minute deltoid. Sepals 5, quincuncially imbricate, two inner ones with scarious margins. Corolla infundibuliform, tube short, slightly thickened; lobes spreading, imbricate in bud. Staminodes 5, alternipetalous, inserted in the throat. Stamens 5, epipetalous; filaments short, connate with the base of the petals; anthers basifix, slightly extrorse, 2-celled, longitudinally dehiscent. Ovary superior, 1–2-celled, glabrous, contracted into a short stout style; cells with 1 apotropous, ascending ovule, attached to the basis of the central axis; stigma truncate, capitate or faintly 2-lobed. *Fruit* drupaceous, 1–(2)-seeded, ovoid to oblong; pericarp thin. Seeds with a thin-crustaceous pale dull testa. Hilum small, round, basal; albumen absent; cotyledons thick; radicle inferior.

Distr. 6 *spp.* of this mono-generic family occur in SE. Asia and Malaysia.

Ecol. Scattered in mixed forests from the lowland up to  $\pm$  1100 m.

Uses. The wood of the moderate-sized *S. paniculatum* is rather soft and not durable; in Sumatra it is used as timber (HEYNE, Nutt. Pl. (1927) 1245); MARCO described it in detail anatomically (Trop. Woods 5 (1933) 1).

Notes. The genus is closely allied to the *Sapotaceae*; its wood anatomy is only slightly different. Herbarium specimens are often not recognized and confused with other families.

#### KEY TO THE SPECIES

1. Apex of the petiole with distinct auricles. Leaves oblong to elliptic, 6–28, by  $3\frac{1}{2}$ –10 cm, dark brown *s.s.*; glandular pits scattered on undersurface; secondary nerves 6–11. Ovary 2-celled

1. *S. paniculatum*

1. Auricles absent. Leaves rather broad, 11–36 by 3–13 cm, slightly pubescent below, light brown *s.s.*; glandular pits absent; secondary nerves 7–16. Ovary 1-celled . . . . . 2. *S. uittienii*

1. *Sarcosperma paniculatum* (KING) STAFF & KING, *l.c.* Pl. 7 (1901) t. 2690; LAM, *l.c.*—*Bracea paniculata* KING, *l.c.*—*Discocalyx macrocarpa* ELMER, *Leaf.* 8 (1915) 2781.—*Apoia macrocarpa* MERR. *l.c.*—*Sarcosperma brevircamosum* H. J. LAM, Bull. J. B. B. III, 8 (1926) 21.

Laticiferous tree, 12–27 m, unbranched bole 6–17 m, 20–50 cm diam., crown spreading. *Leaves* glabrous, opposite or scattered, oblong to elliptic, base acute to  $\pm$  acuminate, apex gradually bluntly acuminate, 6–28 by  $3\frac{1}{2}$ –10 cm, auricles acute  $\frac{1}{2}$ –2 mm long; petiole 1–2½ cm. Stipules subulate, glabrous, ca 4 mm long. Inflor. glabrous or slightly tomentose, either paniculate, 1–14 cm long with branches 2–9 cm, or hardly branched 8–16 mm long; bracts glabrous, acute, 1 mm long. *Flowers*

thickish, waxy yellow to pale greenish white, fascicled or solitary; pedicels 1–1½ mm. Sepals roundish or broadly acute 2 mm through. Corolla tube 1 mm, lobes ovate 3 by 2 mm. Staminodes acute 1 mm. Stamens ovoid 1 mm through. Ovary 2 by 1 mm; style 1 mm. *Fruit* ovoid, 17–20 by 17–15 mm, 1-(rarely 2-) seeded, 3 mm stalked; hilum 3 by 4 mm.

Distr. *Malaysia*: Mal. Peninsula (Perak), N. Sumatra, Br. N. Borneo, Mindanao, S. Celebes, Ternate, Flores, and E. New Guinea.

Ecol. Scattered in dense or open mixed rain-forests, rarely in forest borders, among bamboos, or in secondary jungle, in the Malay Peninsula below 250 m, elsewhere ascending to 1100 m. Fl. and fr. irregularly.



Fig. 1. *Sarcosperma uittienii* H. J. L. a. flowering branch,  $\times 1/2$ , b. bud, c. flower diagram, d. part of the corolla and calyx within, e. ovary in longitudinal and cross-section.

Vern. Not constant, few noted.

Notes. It is probable that more specimens are hidden among indeterminates in several families.

2. *Sarcosperma uittienii* H. J. LAM, Bull. J. B. B. III, 8 (1926) 19, f. 1, &c.—*S. sumatranum* UITT. ex LAM, l.c.—Fig. 1.

?Tree. Leaves fairly opposite, oblong-elliptic to ovate or obovate, both base and apex acuminate, glabrous above glabrescent below; petiole 12–20 mm. Inflor. densely minutely tomentose, generally broadly and laxly paniculate, sometimes almost unbranched,  $3\frac{3}{4}$ – $13\frac{1}{4}$  cm long, branches  $1\frac{1}{2}$ – $6\frac{3}{4}$  cm long; bracts tomentose, deltoid 1–2 mm long. Flowers fascicled or solitary *only known in bud*; pedicels 2–4 mm. Calyx densely tomentose,  $2\frac{1}{2}$  by 2 mm. Corolla tube  $\frac{1}{2}$  mm long, lobes obovate,

2– $2\frac{1}{2}$  mm. Stamnodes deltoid  $\frac{1}{2}$  by  $\frac{1}{3}$  mm. Stamens ovoid, 1 mm through. Ovary glabrous,  $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm. Style 1 mm. Fr. unknown.

Distr. *Malaysia*: only known from Sumatra (Eastcoast Res.).

Ecol. Forests, ca 500 m. Fl. June–July.

Vern. Only once noted.

Notes. Inadequately known. Closely related to *S. kachinense* (KING & PRAIN) EXELL from Burma & China, and to *S. arboreum* Hook. f. from India to China.

#### Excluded

*Sarcospermum petasites* REINW. ex DE VRIESE, Reinwardt's reize (1858) 576 = *Gunnera macrophylla* BL. (*Halorrh.*).

# STACKHOUSIACEAE (F. I. Brouwer, Groningen)

## STACKHOUSIA

J. SMITH, Trans. Linn. Soc. Lond. 4 (1798) 218; PAMP. Bull. Herb. Boiss. II, 5 (1905) 912; BROUWER, Blumea 3 (1938) 173; MATTEI, in E. & P. ed. 2, 20b (1942) 240.

Annual, or perennial herbs with a rhizome. *Leaves* scattered, entire. Stipules 0 or very small. Racemes terminal. *Flowers* bisexual, regular, 5-merous, in groups in the axils of bracts. Sepals usually more or less connate, rarely free. Corolla perigynous or almost hypogynous, petals long-clawed, rarely entirely free, usually free at the base, connate in the upper portion of the claws, lobes imbricate spreading. Stamens 5, inserted on the margin of the calyx tube, free, usually unequal (2 shortest), included in the corolla tube. Ovary (2-)3(-5) celled, lobed, each cell with 1 erect ovule. Style with (2-)3(-5) stigmatic lobes, partly sunk in the ovary. *Fruit* with (2-)3(-5) one-seeded cocci and a columella.

Distr. *Ca* 19 spp. in Australia, 4 in Tasmania, 1 in New Zealand and 1 in Malaysia, Australia and Micronesia (Palau, Jap).

Notes. The family consists next to the genus *Stackhousia*, the single one by which it is represented in Malaysia, of 2 other monotypic genera, and is practically confined to Australia. It is not directly allied to any other family and has been compared with e.g. *Euphorbiaceae*, *Celastraceae*, *Sapindales*, &c.

**1. *Stackhousia intermedia*** F. M. BAILEY, Q. Agric. J. 3, 4 (1898) 174; Q. Fl. (1899) 264; PAMP. l.c. 1149, cum f. *philippinensis*; BROUWER, Blumea 3 (1938) 174; STEEN. J. Arn. Arb. 28 (1947) 422. —*S. muricata* (non LINDL.) auct. plur. quoad Philip. —*St. viminea* (non J. Sm.) VOLKENS, Bot. Jahrb. 31 (1902) 467; id. var. *micrantha* LAUTB. Nachr. Fl. Deut. Sch. Geb. Süds. (1905) 305. —*St. tenuissima* var. *ramosa* STEEN. Nova Guinea 14 (1927) 307. — Fig. 1—2.

Erect, glabrous annual, 6–50 cm long. Root fusiform, up to 5 cm long, 1½ mm diam. at the base, attenuate, with fibrous ramifications. Stem gradually attenuate to the almost filiform angular apex, little branched and leafy below, terete, striate, internodes ½–3 cm long. *Leaves* linear, sessile, base attenuate, 7½–20 by ½–2 mm, lower obtuse, upper acute to mucronate, nervation absent or midrib visible. Racemes 1–20 cm long. *Flowers* minute yellow, upper groups 1–3 fls and 2 bracteoles, lower groups with more bracteoles and up to 5 fls. Bracts roundish ovate, strongly acuminate, fimbriate, dentate, ¾–1 by ½ mm, membranous except the midrib. Bracteoles like the bracts but more dentate and less acuminate. Pedicels ¾–1¼ mm. Calyx-tube ½ mm high, lobes ovate-acuminate, ½ mm long, irregularly fimbriate-dentate, margin membranous. Corolla inserted on the margin of the calyx-tube, sympetalous, hypocraterimorphous, tube cylindrical, 2 by ½ mm, divided into 5 petals in the lower portion over ¼ mm, lobes ovate-oblong, strongly acuminate, ca ¾ mm long. Filaments filiform, 2 shorter ones reaching the middle, 3 longer ones the margin of the corolla-tube; anthers oblong, very obtuse and emarginate at base and apex, 0.6 by 0.3 mm, introrse, dithecic, 4-lo-

cular. Ovary subglobose, 0.3–0.4 mm diam. 3-lobate, 3-celled. Style straight, 0.4 mm long, with 3 linear stigmas. *Cocci* 3, roundish ovate, 1½ by 1 mm, reticulate.

Distr. Australia, Micronesia, and Malaysia: Sumatra (Toba-Batak Lands), N. Celebes, Philippines (Luzon, Culion, Guimaras), Moluccas (Boeroe, Ambon, Saparoea), New Guinea, 10–100–300–600–1500 m alt.—Fig. 1.

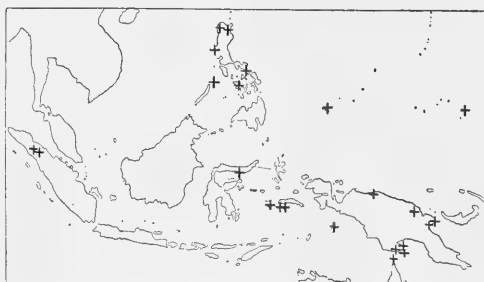


Fig. 1. Localities of *Stackhousia intermedia* BAILEY in Malaysia.

Ecol. Lank herb mostly in grassfields, savannahs and abandoned fields, in both wet and dry spots, in Sumatra at 600–1400, but in E. Malaysia & Micronesia below 300 m, in the Philippines ascending to 1500 m. *Fl.* mostly in April–May together with the grasses.

Notes. *St. tenuissima*, *virgata*, *aphylla* and *micrantha* PAMP. l.c. are most probably all identical with this species.



Fig. 2. *Stackhousia intermedia* BAILEY,  $\times \frac{1}{2}$ , fruits and flowers enlarged.

# ACTINIDIACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. ACTINIDIA

LINDL. Nat. Syst. ed. 2 (1836) 439; B. & H. Gen. Pl. 1 (1862) 177; BENTH. Fl. Hongk. (1861) 26; KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 145, t. 176; E. & P. ed. 2, 21 (1925) 36.

Trailing *shrubs* or *lianas* without special organs for climbing, branches rarely flexuose; stem with wide vessels, raphides in the flowering parts; bark often with short linear lengthwise lenticels. Growth in flushes from terminal and axillary buds. Indumentum of stellate or simple hairs. Stipules minute, obsolete, or absent. *Leaves* simple, scattered, petiolate, serrate or callous-dentate, penninervous, midrib sulcate, veins in cross-bars, veinlets reticulate. Inflor. lateral, often on a common peduncle forked at the apex, cymose, often pseudo-umbellate; bracts 2, at the apex of the peduncle. *Flowers* mostly white, dioecious (or polygamous), 5(–4)–merous. Sepals distinctly imbricate (rarely valvate), free or subconnate at the base, persistent. Stamens (10–)  $\infty$ , in  $\varnothing$  fls with short filaments and small sterile anthers; filaments thin, anthers versatile, base divaricate, attached in the middle, reflexed in bud, dehiscing lengthwise. Disc absent. Ovary free, superior, tomentose (or glabrous), (5–)  $\infty$ -celled; ovules attached on the central axis. Styles free, (5–)  $\infty$ , persistent, elongating after flowering in  $\varnothing$ ,  $\pm$  clavate, spreading, in  $\sigma$  ovary small, with minute styles. *Berry* glabrous (or hairy), often spotted by lenticels, oblong. Seeds  $\infty$ , small, biconvex, oblong, immersed in pulp; testa cartilagineous, reticulate-pitted, dark when dry; albumen copious; integuments 1; embryo cylindrical straight, cotyledons short.

Distr. *Ca* 30 spp. from W. Malaysia & Himalaya to Sachalin, Japan and Formosa, centering in China and Japan.

Ecol. Forests and forest borders, in the montane zone mostly.

Notes. Both Malaysian species appear to be strictly dioecious; the number of  $\sigma$  and  $\varnothing$  sheets in *A. callosa* is about equally large; on Mt Kinabalu only  $\varnothing$  have been found of *A. latifolia*. The total number of specimens examined is inconsiderable; the species are either rare or little collected being inconspicuous. The genus *Actinidia* is often included in *Theaceae*, *Dilleniaceae*, or even *Ericaceae*, and it is closely related to *Saurauiceae* from which it differs in its trailing or climbing habit, absence of scale-like emergences (except in *A. strigosa*), mostly dioecious fls, ebracteate pedicels, lengthwise dehiscing anthers, numerous styles, and a multilocular ovary. I wish to express my sincere thanks to Mr H. K. AIRY SHAW and to Mr M. R. HENDERSON for verifying the MS. of this contribution with the materials preserved at London and Singapore respectively.

### KEY TO THE SPECIES

1. Leaves either glabrous or subglabrous, or provided with simple pluri-celled hairs. Petals glabrous. Inflorescences short . . . . . 1. *A. callosa*
2. Leaves glabrous or subglabrous . . . . . var. *callosa*
2. Leaves rather distinctly submentose beneath . . . . . var. *pubescens*
1. Leaves stellate-tomentose beneath. Petals pubescent on the back. Inflorescences often well-developed. Peduncle  $1\frac{1}{2}$ –8 cm . . . . . 2. *A. latifolia*

1. *Actinidia callosa* LINDL. Nat. Syst. ed. 2 (1835) 439, s.l.; K. & V. Bijdr. 3 (1896) 280; BACKER, Schoolfl. (1911) 102; DUNN, J. Linn. Soc. 39 (1911) 405; KOORD. Exk. Fl. 2 (1912) 602; Fl. Tjib. 2 (1923) 179; BAKER, J. Bot. (1924) Suppl. 9; STEEN. Bull. J.B.B. III, 13 (1934) 174.—See further under var. *pubescens*.

Rambling or trailing shrub or liana up to 30 m, twig-lenticels distinct, wood and inner bark orange. Petiole red s.v., 1–4 cm, blade rather variable in shape ovate-elliptic or obovate, acuminate, midrib

red s.v.,  $5\text{--}10\frac{1}{2}$  by  $2\frac{1}{2}$ –6 cm, sidenerve *ca* 5–6 pairs rather steeply ascending and substraight, insertion decurrent, margin distinctly serrate or dentate, teeth erect at the end of a vein, apex acuminate, base rounded to subcuneate. Indumentum meagre or absent, consisting of short often somewhat crisped pluri-celled simple hairs. Peduncle, pedicels and calyx thin-tomentose. Peduncle  $\frac{1}{4}$ – $1\frac{1}{2}$  cm, pedicels  $\frac{1}{2}$ – $1\frac{1}{4}$  cm, all thin. Dioecious, flowers white, anthers yellow. Sepals ovate-orbicular, *ca* 6 by 5 mm. Petals oblique-broad-spathulate, sub-



Fig. 1. *Actinidia latifolia* (GARDN. & CHAMP.) MERR., habit  $\times \frac{1}{2}$  (after KING).

fleshy, margin  $\pm$  irregular, ca 10 by 7 mm. Stamens  $\infty$  in ca 2 rows, filaments subequal, ca 6 mm (in  $\varnothing$  very short); anthers  $1\frac{2}{3}$  by 1 mm, apex subapiculate (in  $\varnothing$  sterile, hardly dehiscent);  $\varnothing$  fls unknown to me. Ovary stout cylindric, styles ca 2 mm (in  $\sigma$  very small, reduced). *Berry* grey-green, spotted grey or brown, entirely syncarp, oboval to broad-elliptic, often oblique, apex often concave, 17–27 by 14–18 mm, base rounded, sepals recurved. Seeds elliptic, 3 by  $1\frac{1}{2}$  mm.

Distr. SE. Asia, China, Formosa, in *Malaysia*: Sumatra, Java.

Ecol. Mountain forests, forest borders, 1000–2040 m, rather rare.

Notes. Young shoots edible. Leaves sometimes with raspberry-coloured zoocidia consisting of crowded-hairy portions. In Java a juvenile shoot was collected with subcordate subglabrous leaves resembling in shape those of *A. latifolia*. A rather variable species; some of the forms distinguished by DUNN are now taken up as species, wrongly it seems. *A. indochinensis* MERR. apparently belongs here.

var. *pubescens* DUNN, *l.c.* 406.—*Saurauia tomentosa* KORTH. *nomen ex K.* & V. Bijdr. 3 (1896) 280.—*Actinidia pubescens* RIDL. J. Fed. Mal. Stat. Mus. 8, 4 (1917) 18.—Leaves  $6\frac{1}{2}$ – $11\frac{1}{2}$  by  $4\frac{1}{2}$ – $6\frac{1}{2}$  cm, thinly tomentose beneath.

Distr. Assam, in *Malaysia*: Malay Peninsula (HENDERSON 23436), Sumatra (KORTHALS, FORBES).

Notes. Apparently rare, may be confused with *A. latifolia*. The Sumatra specimen has glabrous twigs, the others hairy ones. The indumentum seems partly caducous. I assume KORTHALS's specimens came from Sumatra, not from Java.

2. *Actinidia latifolia* (GARDN. & CHAMP.) MERR. J. Str. Br. R. As. Soc. 86 (1922) 330.—*Heptaca latifolia* GARDN. & CHAMP. in HOOK. J. Bot. & Kew Gard. Misc. 1 (1849) 243.—*Kadsura pubescens* MIQ. Fl. Ind. Bat. Suppl. (1860) 620; KURZ, J. As. Soc.

Beng. 45, II (1876) 119, non *A. pubescens* RIDL. 1917.—*A. championi* BENTH. Fl. Hongk. (1861) 26; FINET & GAGN. Fl. Gén. I. C. 1 (1907) 28; RIDL. Fl. Mal. Pen. 1 (1922) 206.—*A. miquelii* KING, J. As. Soc. Beng. 59, II (1890) 196, *nomen illeg.*; Ann. R. Bot. Gard. Calc. 5 (1896) 145, t. 176.—Fig. 1.

Rambling shrub or liana to 20 m long, twigs dark-coloured *s.s.*, innovations, inflor. and under-surface of the leaves thinly cinnamon- (s.v. rusty-red)-stellate-tomentose. Petiole 2–4 cm; blade broad-ovate, obovate to suborbicular,  $5\frac{1}{2}$ –11 by 3–9 cm, base reniform-cordate to rounded or cuneate, apex acuminate, margin subentire with small callous teeth, veins rusty in distinct cross-bars, reticulations below hidden by a pale closed indumentum, upper surface puberulous. Peduncle rather stout,  $\pm$  remote from the petiole,  $1\frac{1}{2}$ –8 cm long, apex forked,  $\pm$  pseudo-umbellate, rich-flowered, pedicels in fr. apparently enlarging. *Flowers* velvety, light-brown, yellow inside, stamens yellow (*ex coll.*). Only seen  $\varnothing$  buds, these depressed-globose. Sepals tomentose outside. Petals pubescent outside, apex imbricating, basal parts free, blunt, rather roundish, pale green in bud apparently smaller than in *A. callosa*. Anthers numerous  $\pm$  1 mm long, on  $\frac{1}{2}$ – $\frac{3}{4}$  mm long filaments, sterile hardly dehiscent. Ovary depressed-globose, densely pilose,  $1\frac{1}{2}$  mm high. Styles  $\infty$ ,  $\pm$  2 mm long, slender-clavate, overtopping flatly the anther clump. *Berry* acorn-shaped, 3–4 by 2 cm, brown, spotted pale. Seeds broad-elliptic,  $\pm$   $1\frac{3}{4}$ –2 by more than 1 mm.

Distr. China, Indochinese Peninsula, Hongkong, ?Formosa, Hainan, in *Malaysia*: Malay Peninsula, Sumatra, Borneo.

Ecol. Hill forests, rather rare, ca 900–1500 m, fl. April–July.

Vern. Once noted, S. Sumatra, *wait boerah*.

Notes. There is some variability in the size of the inflor. *A. formosana* HAYATA probably belongs here. Expected to occur in the Philippines.





# CERATOPHYLLACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. CERATOPHYLLUM

LINNÉ, Sp.Pl. (1753) 992; MIQ. Fl. Ind. Bat. 1, 1 (1856) 799; BOERL. Handl. 3, 1 (1900) 399; STEEN. Bull. J.B.B. III, 13 (1933) 102; BACKER, Bekn. Fl. Java 3 (1941) no 31.

Submerged, rootless, monoecious freshwater plants. *Leaves* verticillate, 2–4 times forked, segments linear dentate. *Flowers* actinomorphic, solitary, axillary, unisexual. Perianth valvate, segments 9–12, persistent, narrow. ♂: stamens 8–24; anthers nearly sessile rather broad, connective pointed, the 2 cells mostly crowned by a minute bristle; ovary rudiment absent. ♀: ovary superior, sessile, 1-celled with 1 ovule; style persistent, subulate, sulcate towards the apex; stamen rudiments absent. *Fruit* oblong, compressed, warty, not dehiscent, near the base with 2 straight or curved soft spines, or unarmed.

Distr. *Ca* 2 spp., both ubiquitous.

Ecol. In stagnant pools, small slow streams, shallow parts of lakes and ditches, in ponds, often gregarious. The specimens are frequently rough by incrustations of lime. They 'collect' mud on their surface and contribute to the clearing of water as do *Hydrilla*, *Blyxa*, &c. The stems die at their distal end and grow at the top. They propagate easily vegetatively but remain often sterile; near Batavia they are locally rather frequently found flowering in shallow water. The leaves are slack though in *C. demersum* slightly stiffer than in *C. submersum*. On extracting material from the water the leaves join brush-like.

### KEY TO THE SPECIES

1. Leaves mostly 2 times forked, segments 4, rarely 2, 3, or 5. Fruit with 1 apical and 2 basal spines

1. *C. demersum*

1. Leaves mostly 3–4 times forked, segments 7–12. Fruit with 1 apical spine only

2. *C. submersum*

1. *Ceratophyllum demersum* LINNÉ, Sp.Pl. (1753) 992; K. SCH. & LAUT. Nachtr. (1905) 261; VAL. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 11; BACKER, Teysm. 22 (1911) 503; MERR. Fl. Manila (1912) 202; SYBRANDI, De Trop. Natuur 5 (1916) 126; MERR. En. Born. (1921) 247; MERR. En. Philip. 2 (1923) 141; HEYNE, Nutt. Pl. (1927) 616; STEEN. Arch. Hydr. Suppl. 11 (1932) 305; Bull. J.B.B. III, 13 (1933) 103; MCCANN, J. Bomb. Nat. Hist. Soc. 37 (1934) 681; BACKER, Bekn. Fl. Java 3 (1941) no 31.—*C. tuberculatum* CHAM. Linnaea 4 (1829) 504; MIQ. Fl. Ind. Bat. 1, 1 (1856) 799.—Fig. 1.

Plant often much branched up to 3 m long, stems mostly red, internodes 1–3 cm. *Leaves* in whorls of 7–10, dark green when adult, 1–4 cm long, base gradually or abruptly thickened above the middle. Pedicel  $\frac{3}{4}$ –1½ mm. *Perianth* segments 9–12, linear, transparent greenish-white with numerous short brown lines, near the apex with few bristles, 1½–2 mm long. ♂: stamens 8 or more. ♀: ripe fruit black, 4–5 mm long, with 3 spines, apical spine (style) 11–12 mm long, soft, 2 basal ones straight (in Mal. material), patent to slightly recurved, 9–11 mm long.

Distr. Throughout *Malaysia*, not yet known from the Malay Peninsula, ascending to over 1500 m.

Ecol. See above. The 'internodes' of the leaves are sometimes inflated and imitate an articulated structure.

Vern. *Kantjil*, M, *ganggang*, Sd., *ganggang*, J, *hoornblad* (Dutch); the Indonesian names are also used for other waterplants.

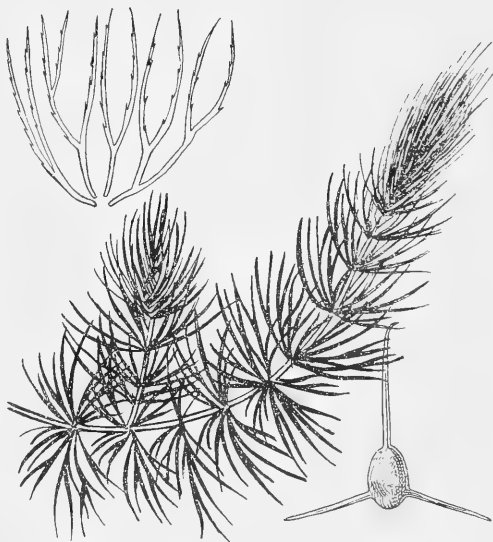


Fig. 1. *Ceratophyllum demersum* L. Habit, detached leaves,  $\times \frac{3}{4}$ , fruit enlarged.

Much like the preceding *sp.*, up to 1 m long, *leaves* in whorls of 6–8, adult ones  $1\frac{3}{4}$ –2 cm long, bright green. Flowers not yet found in Malaysia. ♀: ripe *fruit* black,  $\pm$  4 mm long, only the style thickened into an apical soft spine, basal spines absent.

Distr. In *Malaysia* rather rare: N. Sumatra, Java, Celebes, and New Guinea, at low altitudes.

Ecol. In places as the prec. *sp.*, the New Guinean specimens were found massed in open water in *Melaleuca leucadendron* swamp forest, plant brown (BRASS).

# HYDROCARYACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. TRAPA

LINNÉ, Sp.Pl. 1 (1753) 120; MIQ. Fl. Ind. Bat. I, 1 (1855) 635; ANON. Tijdschr. Nijv. & Landb. 30 (1877) 97–100; BOERL. Handl. 1, 2 (1890) 561; VORDERMAN, Teysm. 6 (1895) 313–321; ANON. Tropenpfl. (1905) 703; WIGMAN, Teysm. 22 (1911) 547; WEBSTER, Philip. Agr. Rev. 6 (1913) 138, t. 12; FLEROFF, Bull. Jard. Bot. Rep. Russ. 24 (1925) 13; GAMS, Pfl. Areale I, 3 (1927) 39; OCHSE, Ind. Vrucht. (1927) 98; HEYNE, Nutt. Pl. (1927) 1206; BURK. Dict. Ec. Prod. Mal. Pen. 2 (1935) 2173; BACKER, Bekn. Fl. Java 4 a (1942) no 75, p. 11.

Floating aquatic herbs with dimorphic leaves, submerged ones opposite pinnatifid rootlike, apical ones in a rosette, rhomboid, dentate, with spongy often inflated petiole, arranged in leaf-mosaic; stipules 4–8, minute. Flowers bisexual, small, solitary, axillary, short-pedicelled, 4-merous, white or lilac. Petals imbricate. Disk present. Ovary half-inferior with 1 style and 2–4 persistent sepals turning often to thorns or horns. Fruit mostly 1-celled, 1-seeded, shell bone-hard; thorns after withering often set with barbs at the apex. Seed often producing 2–5 free germ-stalks.

Distr. Several species in the Old World, but not known from Australia.

Ecol. *Trapa* is very rare and was for the first time reported in 1877 in Java. It is surely a component of the old lowland eutrophous swamp flora such as is preserved in the Danoe swamp (Bantam).

Use. The fat-containing kernels of *T. bicornis* are highly nutritious and are eaten in West Java but not on a scale comparable to that of several parts of Asia, where it is a staple food.

Notes. Sometimes included in the *Onagraceae* or *Halorrhagaceae*. The names are those given by H. GLÜCK in sched. Herb. Bog. There is little agreement about the specific distinctions in the genus *Trapa*.

### KEY TO THE SPECIES

1. Fruit triangular to 4 cm high, 7–8 cm broad with 2 large horns. Leaves green . . . 1. *T. bicornis*
1. Fruit tetrahedral, 1–1½ cm high, thorns 4, dagger-like, often unequal. Leaves spotted black at the base . . . 2. *T. maximowiczii*

1. *Trapa bicornis* OSBECK var. *cochinchinensis* (LOUR.) GLÜCK.–OSBECK, Dagb. Ostind. Resa (1757) 191; LINNÉ f. Suppl. (1781) 128; VORDERMAN l.c. 313; MERR. Comm. Lour. (1935) 290; HEYNE, Nutt. Pl. (1927) 1206; OCHSE, l.c. f. 47.—*T. cochinchinensis* LOUR. Fl. Coch. (1790) 108; BACKER, Ann. J.B.B. Suppl. 3 (1910) 418.—*T. chinensis* LOUR. l.c.—Fig. 1f.

Leaves green, petiole 9–20 cm long, blade 5–7 by 6–9 cm. Flowers white. Horns of the fruit very blunt, straight or subcurved, their lateral surfaces bluntly irregularly ribbed.

Distr. Native of Asia, in *Malaysia*: introduced probably by the Chinese, cultivated mostly near Batavia by the Chinese. In Batavia markets fruits are offered for sale of a variety with black sharp-pointed curved points suggesting buffalo horns often referred to as *T. bispinosa* ROXB.; these fruits are imported apparently directly from China (Teysm. 4, p. 499; WEBSTER l.c. fig.).

Vern. *Lengkat*, *lengkong*, *ling*, *lingkok*, *chin*, *kerendan* (Batavia), *calthrop(s)*, *Chinese water chestnut* (Engl.), *waterroot* (Dutch).

Notes. Already in 1879–80, the Colon. Museum, Haarlem, received fruits of *T. bicornis* from Atjeh sent by Mr J. SCHAAR (cf. Tijd. Ned. Mij t. Bev. Nijv. for 1880).

2. *Trapa maximowiczii* KORSHINSKY, Act. Hort. Petrop. 12 (1892) 336; DE VOOGB, Trop. Natuur, 21

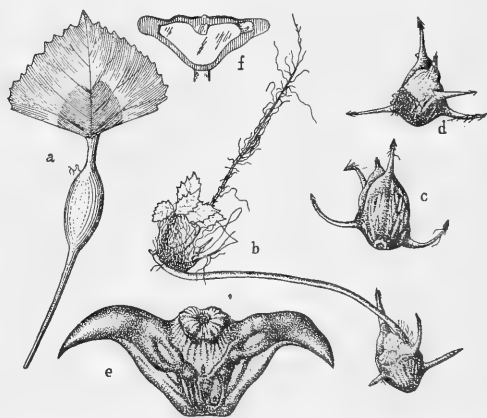


Fig. 1. *Trapa maximowiczii* KORSH. a, leaf, b, germinating fruit, c, d, fruits.—e. *Trapa bispinosa* ROXB. (edible, imported fruits on the market at Batavia).—f. *Trapa bicornis* OSB. var. *cochinchinensis* (LOUR.) GLÜCK (edible, cultivated locally), in section,  $\times \frac{1}{2}$ .

(1932) 62, 63, f. 9.—*T. quadrispinosa* auct. non ROXB.; VORDERMAN *l.c.*; Trop. Natuur 9 (1920) 73, f.; HEYNE *l.c.* 1207; OCHSE *l.c.* fig. 48.—Fig. 1.

Leaf blade towards the base black-brown or with 2 dark spots,  $2\frac{1}{2}$ –4 by  $3\frac{1}{2}$ – $5\frac{1}{2}$  cm, petiole 5–15 cm. Corolla pale lilac, anthers yellow. Fruit tipped by the conical hardened style. Thorns straight or curved often unequal, their apex barbed, surface of the fruit smooth, not ribbed.

Distr. SE. Asia, rare but certainly native in Malaysia: W.-NW. Java (from Indramaju to Bantam, e.g. Danu swamp (ANON. (1877), *l.c.*; VORDERMAN, *l.c.*) and S. Sumatra (Palembang Res., Lake Teloko, near Kaju Agung).

Ecol. Swamps and ponds, disappearing under anthropogenic influence.

Vern. *Salekat*, *salaikat*, M.

Notes. Possibly one of the forms of *T. natans* L. s. *ampl.*

## MORINGACEAE (C. G. G. J. van Steenis, Buitenzorg)

### 1. MORINGA

JUSS. Gen. (1789) 348; Endl. Gen. Pl. (1840) no 6811, p. 1321; B. & H. Gen. Pl. 1 (1862) 430; E. & P. 3, 2 (1891) 244.

Small trees, mostly deciduous, bark gummy, wood soft, roots thickened, pungent; trunk often inflated. *Leaves* spread, imperfectly 2–4-imparipinnate: tissue with myrosin cells; pinnae opposite, provided with stipitate glands at the base of the petiolules and pinnae. Leaflets small, opposite, entire, all articulated. Stipules represented by blunt knobs. *Flowers* bisexual, zygomorphic, white (or yellow streaked red), in axillary panicles. Calyx tube short, as a hypanthium; lobes 5 imbricate, spreading or reflexed, separately dropping. Petals 5 free, anterior one largest and erect, others reflexed, posterior smallest. Disk lining the calyx tube, with a short free margin bearing the androecium. Perfect stamens 5 epipetalous; anthers dorsifixed, 1-celled, oblong, when lengthwise opened broader. Staminodes 5, subulate, with or without rudimentary anthers. Ovary superior, shortly stalked, 1-celled with 3 parietal placentas. Style filiform, stigma small. Ovules  $\infty$ , in 2 series on each placenta. *Capsule* linear, beaked, 3–6-angled; valves thick, spongy, on the inside with pitted cavities in 1 row along the median line. Seeds 3-winged (or exalate), body roundish large. Embryo exalbuminous, straight, containing oil.

Distr. *Ca* 10 spp., confined to the semi-arid countries of Somaliland, Madagascar, SW. Africa, NE. Africa, Asia Minor, 2 spp. in India.

Ecol. Said to be deciduous, but *M. oleifera* is to my knowledge in Malaysia never wholly so, thriving both under wet and seasonal conditions. As far as is known *M. oleifera* never runs wild.

Uses. Numerous uses, cf. under *M. oleifera*.

Notes. Very different opinions have been advanced on the affinity of *Moringa*. DALZELL arranged it with the *Bignoniaceae*; even recently HALLIER f. (Rec. Trav. Bot. Néerl. 15 (1918) 60, 99) followed BENTHAM, MIQUEL and others in assigning *Moringa* to the *Leguminosae* as a syncarpous remote member; GRIFFITH, however, had already predicted (Posth. Pap. 2 (1839) p. xiv, 1849) that polycarpous *Leguminosae* should be apocarpous (as now described in *Archidendron* &c.). The genus is now universally adopted as allied to the *Capparidaceae*. In Malaysia one species occurs, only cultivated.

**1. *Moringa oleifera* LAMK.** Encycl. 1 (1785) 398; —*Morunga* RUMPH. Herb. Amb. 1 (1741) 184 t. 74/5. —*Guilandina moringa* LINNÉ, Sp. Pl. 1 (1753) 381; HORSF. Verh. Bat. Gen. 8 (1816) 107. —*Hyperranthera moringa* VAHL, Symb. bot. 1 (1790) 30; THUNB. Fl. Jav. (1825) 19; JUEL, Pl. Thunb. (1918) 248. —*M. pterygosperma* GAERTN. Fruct. 2 (1791) 314; HASSK. Pl. Jav. Rar. (1848) 413; MIQ. Fl. Ind. Bat. 1, 1 (1855) 350; Suppl. (1860) 115; GRESH. Schetsen (?1895) 63, t. 17. —*M. nux-ben* PERROTTET, Mém. Soc. Linn. Paris 3 (1824) 129; C. B. ROB. Philip. J.Sc. 3 (1908) Bot. 305. —*M. polygona* DC. Prod. 2 (1825) 478; MIQ. Fl. Ind. Bat. 1, 1 (1855) 350, Suppl. (1860) 115. — **Fig. 1.**

Rapid-growing often crooked tree 3–10 m, stem 10–30 cm diam., crown thin, bark with coarse fibre. *Leaves* somewhat crowded towards the twig-ends; twigs lenticellate, with distinct scars; innovations pubescent. Petiole thickened at the base incl. the rachis 25–60 cm, all stalks articulated hence caducous, provided with linear or clavate often curved glands; jugae 8–10. Petiolules 1–6 mm, blades ovate, obovate or oblong, 9–20(–30) by 5–12(–18) mm, tip rounded or slightly emarginate, lower surface pale green, nerves obscure not prominent. Panicles erect, 10–30 cm; bracts small. *Flowers*

white with greenish base, fragrant; pedicels 7–11 mm, articulated under their tip. Calyx tube 3–4 mm high; posterior sepal 7–10, anterior 10–14 mm long. Petals hairy towards the base, anterior one 14–17 by 6–8 mm, posterior ones 10–13 by 5–8 mm. Stamens and staminodes with hairy base, directed to the largest petals, apex of the filaments recurved. Gynophore 2–3 mm. Ovary 3–4 mm high, densely hairy; style upwards glabrous with hollow stigma. *Capsule* pendent, dagger-shaped, subtorulose, 18–45 cm long, valves with 3 strong blunt ribs. Seeds 10 mm diam., wings 25 by 4–7 mm, subsequent ones partly overlapping; testa reticulate.

Distr. Indigenous in NW. India, in *Malaysia* introduced at an early date, now planted throughout the settled areas in all tropics, not run wild, sometimes found as a culture relic in abandoned places, up to *ca* 500 m.

Ecol. Flowers throughout the year, fr. mostly Sept.–Nov. Exclusively propagated by cuttings. Germination hypogaic. Colibris, and in India honey-suckers, are reported to visit the flowers. Once coralloid twig-galls 10–30 cm diam. were found in W. Java. Damage of the stem by insects causes quick exudation of gum.

Vern. *Horse radish tree* (Engl.), *kèlor*, J, M, Md,

*marongghi*, Md, *marunga* (Timor), *k(o)lèntang* (fruct.), *malungay*, Tag. Philip., *gemunggai*, *mering-gai* (Mal. Pen.), and many others.

Uses. Many: flowers, leaves and immature fruits as vegetable. Leaves and bark (specially of the roots) medicinal. Bark-gum and seed-oil not

valuable. Treelet sometimes used for living fences or as supporting tree for pepper vines (cf. RUMPHIUS, GRESHOFF, HEYNE, BURKILL, &c.).

Wood anat. *M. sp.*: MOLL & JANSONIUS Mikr. Holzes 2 (1908) 513; *M. oleifera*: TANG, Bull. Fan Mem. Inst. of Biol. 6 (1935) 153. Both microsc.



Fig. 1. *Moringa oleifera* LAMK,  $\times 1/3$ .

## SAURURACEAE (C. G. G. J. van Steenis, Buitenzorg)

Rhizomatose, aromatic or pungent, perennial, often stoloniferous herbs. Stem articulated. *Leaves* simple, entire, scattered (not alternate), often oblique; leaf base mostly reniform-cordate, nervation mostly palmate. Petiole sheathing or an intrapetiolar stipule. *Flowers* bisexual, actinomorphic, small, in terminal spikes or racemes or opposite the leaves (sympodial), each in the axil of a bract, bract sometimes connate with the pedicel; lowest bracts sometimes petaloid. Perianth absent. Stamens 3, 4, 6 or 8, sometimes partly abortive, free or adnate to the basal part of the ovary or epigynous. Anthers 2-celled, splitting lengthwise laterally or extrorse. Ovary composed of 3–4 connate carpels, or 1-celled with 4–3 parietal placentas. Styles free or connate at the base, often recurved, stigmatose on the inner surface. *Fruit* capsular opening at the top, or consisting of tubercled indehiscent 1-seeded cocci.

Distr. 4 genera, 2 in E. Asia, 1 in California, and 1 both in Asia and Atlantic N. America; the latter with 2 species, the others monotypic.

Ecol. Mostly in marshy places.

Uses. In China and N. America medicinal with acrid and adstringent properties.

Notes. Formerly sometimes included in *Piperaceae*. A key to the genera is given in *Blumea* 6 (1948) 244–245.

### KEY TO THE GENERA

1. Short spike of sessile flowers subtended by 4 petaloid bracts. Intrapetiolar stipule distinct

1. *Houttuynia*

1. Elongating raceme. No petaloid bracts at the base of the raceme. Petiole sheathing

2. *Saururus*

### 1. HOUTTUYNIA

(*non* HOUTT. 1780) THUNB. Fl. Jap. (1784) 12, *nom. gen. conserv. prop.*; E. & P. 3, 1 (1889) 3, *excl. syn.* *Gymnotheca* DECNE, *Anemopsis* HOOK. & ARN.

Stoloniferous. *Leaves* palminervous. Spikes peduncled. Stamens 3, filaments adnate to the base of the ovary. Ovary 1-locular, consisting of 3 partially connate carpels; placentas parietal. *Fruit* subglobose, opening at the apex. Seeds globose.

Distr. Monotypic, from India & Indo-China to Japan and Formosa, in *Malaysia* doubtfully native.

Notes. The generic name *Houttuynia* THUNB. should be preserved against the older *Houttuynia* HOUTT. and was proposed for the list of *Nomina generica conservanda* (Fl. Mal. Bull. 3 (1948) 73).

1. *Houttuynia cordata* THUNB. Fl. Jap. (1748) 234, t. 26; MIQ. Fl. Ind. Bat. 1, 2 (1859) 457; T. & B. Cat. Hort. Bog. (1866) 72; MERR. Comm. Lour. (1935) 126; STEEN. Trop. Nat. 26 (1937) 147; *Blumea* Suppl. 1 (1937) 137.—*Polypara cochinchinensis* LOUR. Fl. Coch. (1790) 61.—*P. cordata* O.K. Rev. Gen. (1891) 565.—Fig. 1.

Root-stock copiously branching, up to more than 1 m long. Stems erect or ascending, up to 50 cm long. *Leaves* broad-ovate, base reniform-cordate, apex acuminate, 3–8½ by 2½–6½ cm; petiole 1–4 cm. Petaloid bracts white, oblong, ± 1–1½ cm long. Spike 1–2 cm long. Seeds ½–⅔ mm long, ellipsoid, testa of dry seed reticulate.

Distr. Under temperate conditions from the Himalaya to E. Asia, also in Formosa, in *Malaysia*:

only once found in W. Java, ca 1250 m alt., questionably native. Might be expected to occur in Luzon or Mindoro.

Ecol. A tenacious and obnoxious weed; crushed leaves with a fishy or fleshy smell, in W. Java found in a tea-plantation and a neighbouring bamboo grove.

Uses. A Chinese drug plant and vegetable.

Vern. *djukut hanjir*, Sd, after the peculiar smell which much intrigued the Sundanese workers in the plantation and gave rise to a legend that the plant proceeded from the flesh and blood of a man who was killed by a tiger in the same spot. On account of the smell there was even trouble with Javanese weeders.

### 2. SAURURUS

LINNÉ, Sp.Pl. (1753) 341.—*Spathium* LOUR. Fl. Coch. (1790) 217.—*Mattuschkia* GMEL. Syst. 2 (1791) 589, *non al.*—*Saururopsis* TURCZ. Bull. Soc. Nat. Mosc. 21 (1848) I, 589; BAILL. Adans. 10 (1871) 69.—*Saururotus* ENGL. E. & P. 3, 1 (1887)



2.—*Neobiondia* PAMP. Nuov. Giorn. Bot. Ital. 17 (1910) 263; GAGNEP. Not. Syst. 2 (1911) 283.

Tall erect herbs up to 1 m or more. *Leaf base* reniform-cordate. *Flowers* in the axils of bracts, or pedicels connate with the bracts. Stamens (8)–6, or by abortion only 4, sometimes opposite the carpels, sometimes lateral; filaments  $\pm$  free. Ovary composed of (3)–4 carpels connate at their base, each with 2(–4) ovules, only one developing. Styles free, recurving. *Fruit* depressed-globose, said to be subfleshy, parting into (3)–4 tubercled cocci. Testa of roundish seed reticulate.

Distr. 2 species, one in E. Asia, 1 in Atlantic N. America.

Notes. *Gymnotheca* DECNE (*S. cavaleriei* LÉV.) constitutes a distinct genus. The N. American *S. cernuus* L. is apparently distinct through a slightly different leaf-shape, very long filaments and nodding spikes. These differential characters ought to be further studied.

1. *Saururus chinensis* (LOUR.) BAILL. Adans. 10 (1871) 71; LOUD. Hort. Brit. (1830) 144, *nomen*;

LOUD. Encycl. Pl. (1866) 289; T. & B. Cat. Hort. Bog. *inedit.* (1854) 63, *nomen*; *ib.* (1866) 77 (*sinensis*); MERR. En. Philip. 2 (1923) 2; GROFF, Lingn. Sc. J. 11 (1932) 84; MERR. Comm. Lour. (1935) 126.—*Spathium chinense* LOUR. Fl. Coch. (1790) 217, *ed.* WILLD. (1793) 270.—*S. cernuus* (non L.) THUNB. Fl. Jap. (1784) 154.—*S. loureiri* DECNE, Ann. Sc. Nat. III, 3 (1845) 102; C.D.C. Prod. 16, 1 (1869) 239; F.-VILL. Novis. App. (1880) 174; VIDAL, Phan. Cuming. (1885) 138; Rev. Pl. Vasc. Filip. (1886) 219.—*Saururopsis chinensis* TURCZ. Bull. Soc. Nat. Moscou 21, 1 (1848) 589.—*S. cumingii* C.D.C. Prod. 16, 1 (1869) 239.

Glabrous, except for pedicels & rachis. Stem ribbed, pithy, lower part terete, upper part angular; lower leaves amplexicaulous, leaving annular scars, upper ones half-amplexicaulous, stem somewhat zigzag towards the apex, internodes 1–4 cm; lower petioles  $6\frac{1}{2}$ , upper ones  $3-1\frac{1}{2}$  cm long. Leaf blade mostly oblique, base reniform-cordate-truncate, apex acute to slightly acuminate, palmatinervous with 5 larger and 2 feeble nerves, shape ovate-lanceate,  $8\frac{1}{2}-12\frac{1}{2}$  by  $3\frac{1}{2}-6\frac{1}{2}$  cm. Spikes straight, bracts in bud pine-like imbricating, 5–8 in fruit to 15 cm long; peduncle glabrous, 1–3 cm. Rachis and pedicels pubescent. *Flowers* white, fragrant. Bracts ovate to roundish, or broad-spathulate, their blade 1–2 by 1–2 mm,  $\pm$  ciliate, with brown dots (glands) in the parenchyma, connate with the  $1\frac{1}{2}-3$  mm long pedicels and winging these; rachis angular by the decurrent pedicels. Anthers 4 behind the carpels, or 6 (in two lateral of the carpels), or 8. Filaments  $\pm \frac{1}{3}-\frac{1}{2}$  (– $\frac{3}{4}$ ) mm; anthers  $\pm$  convex, elliptic,  $\pm \frac{3}{4}-1$  mm long, extrorse. *Cocci* 4, tubercled,  $1\frac{1}{2}$  mm long; style recurved *ca*  $\frac{1}{2}$  mm. Seed ovoid, fine-reticulate,  $\frac{5}{6}-1$  by  $\frac{2}{3}-\frac{3}{4}$  mm.

Distr. Indo-China & Hainan to Central China, Japan, Riu Kiu and Formosa, in *Malaysia* only in Luzon (Ilocos Norte, Bontoc), in swampy places, muddy banks, rice-fields, 50–1100 m.

Notes. It should be studied whether there are several sexual forms showing floral dimorphy.

Uses. Used as a drug in China (GROFF *l.c.*).

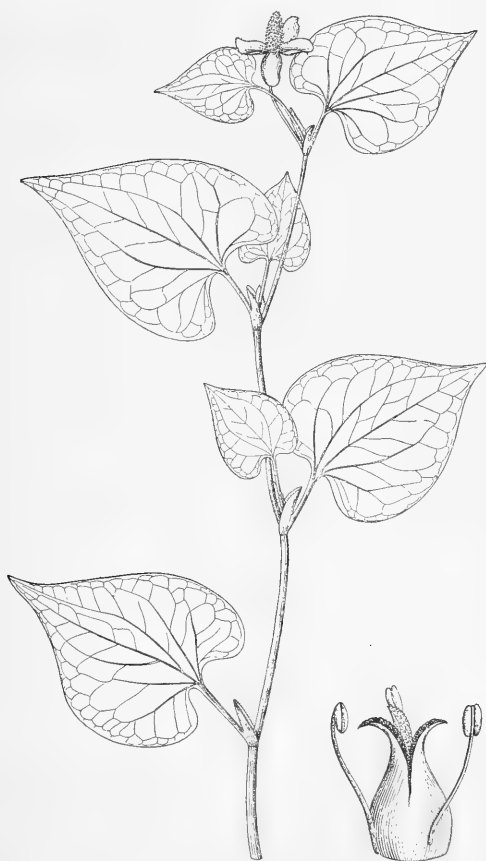


Fig. 1. *Houttuynia cordata* THUNB., habit  $\times \frac{2}{5}$ , flower enlarged.

## STYRACACEAE (C. G. G. J. van Steenis, Buitenzorg)

Evergreen trees or shrubs. *Leaves* simple, spirally arranged, sometimes pseudo-alternate, margin entire or toothed, mostly with stellate or lepidote indumentum. Stipules 0. *Flowers* bisexual, actinomorphic, axillary or terminal. Calyx tubular more or less adnate to the ovary; lobes if present valvate. Corolla rarely of free petals, mostly united in a basal tube, 4–7, valvate or imbricate. Stamens equal and alternate, or double the number of the petals, mostly adnate to the tube. Disk absent; anthers 2-celled, introrse, splitting lengthwise. Ovary superior, rarely semi-inferior, 3–5-celled. Style 1; stigma punctiform to 3–5-lobed. Ovules 1– $\infty$  in each cell, axile. *Fruit* capsular (rarely drupaceous) 1– $\infty$ -seeded, dehiscent or not, pericarp often thick and woody or corky, with a persistent calyx. Seeds with copious endosperm and straight or slightly curved embryo.

*Distr.* *Ca* 12 genera mostly in the N. hemisphere, absent in Australia and the Central Pacific, richly developed in E. Asia. No *Styracacea* has yet been found in the Philippines proper, Central & East Java, and the Lesser Sunda Isl.. Sumatra is the richest centre in Malaysia.

*Ecol.* *Styrax* represents a northern type in the Malaysian flora but its representatives are found both in the lowland and the mountains up to *ca* 1600 m alt. Most peculiar galls are found in *Styrax*, caused by specially adapted Aphids, which surpass the European oak galls in variety (*cf.* DOCT. v. LEEUWEN, Bull. J.B.B. III, 4 (1922) 147; Zoocec. D.E.I. (1926) 452; Tijds. Entom. 75 (1932) Suppl. 97; Ned. Kruidk. Archief 51 (1941) 217, and J. C. VAN DER MEER MOHR, Natur & Museum 63 (1933) 163, 6 fig.).

*Uses.* The wood is little used. Of some *Styrax spp.* the bark after having been softened by taps yields *benjoin* resin from incisions made in the bruised portion. This resin contains benzoic or cinnamic acid. Tapping benjoin is a common procedure in Sumatra, mainly Palembang and Tapanuli Res.. Benjoin is used as an antiseptic, in cigarettes and ceremonials, and is an important forest product of Sumatra.

*Wood anat.* See also generic descriptions. The ground tissue by MOLL & JANSSONIUS (2 (1920) 472) called fiber tracheids according to REINDERS's definitions (Handl. 3 (ed. 1941) 145) are libriform fibers; checked by C.A.R.-G.

*Notes.* The genus *Symplocos* was formerly often included in the *Styracaceae* or *Styracineae*, but is accepted to represent a separate family *Symplocaceae* in this Flora. *Styracaceae* possess stellate hairs, or scales, not fasciculate stamens, linear anthers, a half or wholly superior ovary, an imperfectly celled fruit, and differ, moreover, anatomically distinctly from the *Symplocaceae*.

### KEY TO THE GENERA

1. Pedicels articulated. Flowers dull-creamy; lobes and stamens free. Ovary glabrous, imperfectly 5-celled. Seeds minute, numerous. Leaf margin serrulate . . . . . **1. Bruinsmia**
1. Pedicels not articulated. Flowers white; lobes and stamens connate in a basal tube. Ovary hairy, imperfectly 3–4-celled. Seed 1(–2), large. Leaf margin subentire . . . . . **2. Styrax**

### 1. BRUINSMIA

BOERL. & KOORD. Nat. Tijds. N.I. 53 (1893) 68; PERK. Pfl.R. 30 (1907) 14, 88; PERK. Gatt. Styr. (1928) 8, 13, 16, 24; STEEN. Bull. J.B.B. III, 12 (1932) 215.

Glabrate tree with flattened-angular branchlets through decurrent petioles. *Leaves* serrate, brownescent. *Flowers* in (mostly foliate) terminal thyrses. Pedicel with 1 bracteole, articulated at the apex. Buds solid. Calyx broad-campanulate with truncate margin, entire or sub-5-toothed. Corolla-lobes 5(–6), free, imbricate. Stamens 10(–12), 5 longer alternate, 5 shorter epipetalous, or 10 subequal, coherent mutually and with the base of the corolla-lobes. Ovary free for the greater part, imperfectly 5(–6)-locular. Style 5-angular, not grooved. Stigma capitate, sub-5–6-lobed. Ovules  $\infty$ . *Fruit* indehiscent, pear-shaped; style-base mostly persistent. Seeds small, prismatic-4-angular.

*Distr.* Monotypic, endemic in *Malaysia*.

**1. *Bruinsmia styracoides* BOERL. & KOORD. &c. ll. cc.;** STEEN. J. Arn. Arb. 28 (1947) 422.—*B. celebica* KOORD. Med. 's Lands Pl. T. 19 (1898) 525.—**Fig. 1.**

Evergreen tree 15–37 m, diam. 30–150 cm (mostly 25 m by 40 cm); clear bole 7–11 m, without buttresses, bark dirty orange in section. Adult leaves oval to oblong, base mostly rounded, apex acute to acuminate, sparsely hairy,  $7\frac{1}{2}$ –19 by 3–10 cm; primary nerves 6–10 pairs; petiole sulcate 1–1½ cm long. Thyrses 10–25 cm. Pedicels 2 mm; bracteole narrow, 1–2½ mm long. Calyx 1½–2 mm high, 5–6½ mm diam. Corolla lobes pubescent on both sides, tip cap-shaped, ovate-oblong, acute, 9–10 by 4–4½ mm. Stamens 5–5½ and 6–6½ mm long, sometimes subequal 3½–4 mm; filaments glabrous or short-hairy inside and marginal; cells 1½–3 mm long. Ovary 2–2½ mm high, 3–3½ mm diam. Style 3–5 mm long. Fruit 6 by 9 to 10 by 6 mm; style remnant ¾–6 mm long. Seeds 1½ mm long.

Distr. Sumatra, W. Java (W of Buitenzorg), Borneo, Celebes, and New Guinea, (400–)700–1600 m alt., expected to occur in the Philippines & Moluccas.

Ecol. In primary or partly devastated forests, rather rare; globose leaf-galls ½–1 cm diam. are found in Borneo and New Guinea.

Vern. Names local and not trustworthy.

Uses. Wood not durable and besides the tree is rare, though dimensions would be sufficient.

Wood anat. MOLL & JANSSONIUS, Mikr. Holzes 4 (1920) 498.

Notes. The Celebes and New Guinea specimens possess hairy anthers.



Fig. 1. *Bruinsmia styracoides* BOERL. & KOORD.,  $\times \frac{3}{4}$ .

## 2. STYRAX

LINNÉ, Sp. Pl. (1753) 444; PERK. Pl. R. 30 (1907) 14, 17; STEEN. Bull. J.B.B. III, 12 (1932) 220.—*Cyrta* LOUR. Fl. Coch. (1790) 278.—*Lithocarpus* BL. ex ROYLE, III. (1839), 261, in syn.

Shrubs or trees, at least the innovations stellate-hairy, tomentose or lepidote. Leaves mostly tomentose below; petiole sulcate. Calyx campanulate to cup-shaped, free, or the base connate with the ovary, truncate, rarely toothed. Flowers solitary, mostly in racemes or leafy panicles. Corolla lobes 5(–6–7), connate at the base with the annular staminal tube. Stamens (8–9)–10(–11–14), erect, connate at the base; anthers split lengthwise. Ovary imperfectly 3-locular, with few ovules per cell, or only 1. Style 3-angular; stigma punctiform or indistinctly 3-lobed. Fruit globular to oblong, dehiscent or not. Seeds 1(–2) attached at its base.

Distr. Ca 120 spp. in the tropics and subtropics of Europe, Asia, Malaysia, and America. In Malaysia the genus is richest in Sumatra, but the widest distributed species, *St. agreste*, is not found in that island.

Wood anat. *St. benzoin*: MOLL & JANSSONIUS, Mikr. Holzes 4 (1920) 503. *St. benzoin* & *St. paralleloneurum*: DEN BERGER, Med. Proefstat. Boschw. 13 (1926) 152 (hand lens).

Notes. In Java *St. tonkinensis* PIERRE furnishing Saigon benzoë is recently cultivated by the Forest Service. In the key below it is to be placed nearest to *St. ridleyanum* but differs distinctly by its narrow buds 7–10 by 2–3 mm.

### KEY TO THE SPECIES

1. Undersurface of adult leaves with a closed tomentum, concealing the parenchyma.
2. Corolla imbricate in bud . . . . . 8. *St. serrulatum* var. *mollissimum*
2. Corolla valvate in bud.
3. Indumentum glaucous without stellate brown hairs or scales in adult leaves . . . 5. *St. oliganthes*
3. Brown stellate hairs or scales present in the indumentum on the undersurface of adult leaves.
4. Tomentum thin with appressed stellate scales. Fruit large, globose to ovoid-globose,  $2\frac{1}{2}$ –3 by  $2\frac{3}{4}$ –3¼ cm. Seed shining brown, base broad, 1½ cm across, hilum 1 cm. 6. *St. paralleloneurum*
4. Tomentum with stellate hairs; scales absent.
5. Arms of brown stellate hairs ½ mm long. Leaves large  $12\frac{1}{2}$ –18 by 6–12 (rarely 8 by 3) cm. Flowers shortly pedicelled, in linear many-flowered racemes. Fruit obovate, tip acute-acuminate,  $1\frac{3}{4}$ –2½ cm diam. . . . . 4. *St. crotonoides*

5. Stellate hairs minute, arms much smaller than  $1/2$  mm.

6. Inflor. much longer than the leaves. Youngest twigs dark-brown. Pedicels 4–9 mm. Buds 9–11 by  $4\frac{1}{2}$ –6 mm. Calyx  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm high,  $4\frac{1}{2}$ – $5\frac{1}{2}$  mm diam. Petals not fleshy, sparsely pubescent inside. Connective shortly pubescent. Stigma large, 3-lobed, thrice as thick as the style

7. *St. ridleyanum*

6. Inflor. mostly shorter than the leaves. Youngest twigs greyish. Pedicels  $1\frac{1}{2}$ –4 mm. Mature buds 12 by 3 mm. Calyx  $4\frac{1}{2}$  mm high,  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm diam. Petals fleshy, median part inside impressed and glabrous. Connective glabrous. Stigma punctiform as thick as the style

3. *St. benzoin*

1. Adult leaves not with a closed indumentum.

7. Corolla valvate. Racemes 2–17-flowered. Petals glabrous inside, 7–10 by 2–3 mm. Style  $8\frac{1}{2}$ – $12\frac{1}{2}$  mm long. Fruit 8–18 by  $3\frac{1}{2}$ – $7\frac{1}{2}$  mm, 1(–2)-seeded, not dehiscent, distinctly rostrate

1. *St. agreste*

7. Corolla imbricate.

8. Fruit apiculate. Calyx sparsely stellate-lepidote. Corolla lobes 16–17 by  $7\frac{1}{2}$ – $8\frac{1}{2}$  mm, stellate-pubescent on both sides. Racemes 2–3-flowered. Style 15–20 mm. Fruit *ca* 12–13 by 8–10 mm,  $\pm$  irregularly dehiscent at the base into 3 valves. Pedicels drooping, 1–2 cm

2. *St. japonicum*

8. Fruit with rounded apex. Calyx tomentose. Flowers mostly in panicle rich-flowered infl. Pedicels shorter, flowers not drooping

8. *St. serrulatum*

9. Pericarp smooth. Leaves mostly subtomentose below. Panicles mostly many-flowered

*var. mollissimum*

9. Pericarp rugose. Leaves subglabrous below. Depauperate racemes

*var. rugosum*

1. *Styrax agreste* (LOUR.) G. DON, Gen. Hist. 4 (1837) 5; PERK. Pfl. R. 30 (1907) 27; STEEN. Bull. J.B.B. III, 12 (1932) 224; J. Arn. Arb. 20 (1939) 220; *ibid.* 28 (1947) 423.—*Cyrta agrestis*

pairs; petiole  $2\frac{1}{2}$ –6 cm. Racemes  $1\frac{1}{2}$ – $12\frac{1}{2}$  cm, lowest fls often axillary. Pedicels frequently united in twos, 4–6 mm, in fr. 9 mm. Calyx 3–5 mm across. Corolla tube  $2\frac{3}{4}$ – $3\frac{1}{2}$  mm high, lobes oblong to lanceolate, acute, outside hairy. Stamens hairy below, upper part narrowed and glabrous, 7–10 mm; anthers linear, as long as the filaments, not glabrous. Ovary with a  $2\frac{2}{3}$ – $1\frac{1}{4}$  mm long beak. Fruit 1–2-seeded, often oblique, rostrate by a 1– $3\frac{1}{2}$  mm long beak. Seed acute at both ends, lengthwise grooved, lepidote, base contracted, 7–13 by  $2\frac{1}{2}$ – $5\frac{1}{2}$  mm.

Distr. From Annam and Hainan through Malaysia to the Solomons & Micronesia, in *Malaysia*: Borneo, Celebes, Moluccas, New Guinea, and Bismarcks, 10–300, rarely to 1000 m alt. in the Solomons and NE. New Guinea.

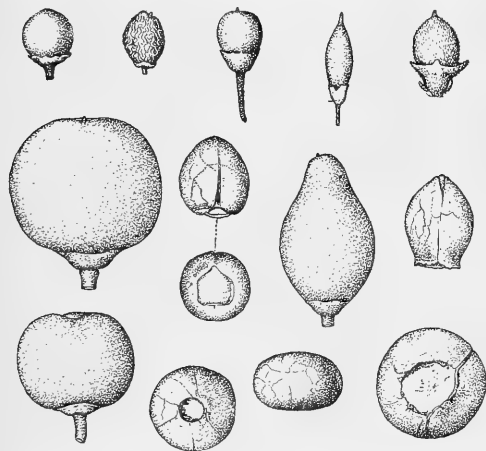


Fig. 2. Fruits and seeds of Malaysian *Styrax*. Upper row from left to right: *St. serrulatum* ROXB. *var. mollissimum* STEEN., *St. serrulatum* ROXB. *var. rugosum* STEEN., *St. oliganthus* STEEN., *St. agreste* (LOUR.) G. DON, *St. crotonoides* CLARKE. Second row: two forms of *St. paralleloneurum* PERK., with seed. Third row: *St. benzoin* DRYAND., right: a seed of *St. benzoin* DRYAND. *var. hiliiferum* STEEN., showing the large hilum,  $\times 3/5$ .

LOUR. Fl. Coch. (1790) 287.—*St. warburgii* PERK. Pfl. R. 30 (1907) 27.—*St. serrulatum* (non ROXB.) HUB. WINKL. Bot. Jahrb. 50 (1914) 195; HALL. f. B.B.C. 34, II (1916) 42.—*St. ledermannii* PERK. Notizbl. 10 (1928) 457.—*St. rostratum* HOSOKAWA, Trans. N. H. Soc. Form. 28 (1938) 65.—Fig. 2, 3.

Shrub or small tree 3–12 m, up to 5 cm diam. Leaves thin, ovate-oblong to ovate-lanceolate, apex acute to acuminate,  $3\frac{1}{2}$ –13 by 2–6 cm; nerves 4–9



Fig. 3. *St. agreste* (LOUR.) G. DON, with fruits and a stem gall intermediate between the coralloid and the alcorniform types,  $\times 1/2$ .

**Ecol.** Undergrowth of primary forests, in Borneo and New Guinea inundated in the wet season, *fl.* and *fr.* mostly simultaneous, March–Nov. From Borneo coralliform twig galls are described.

**Vern.** *Papunti* (SE. Born.), *kaju abu*, *berwewa* (Daj. Koetai), no fixed name.

**Notes.** A Hainan specimen was distributed as *St. subcrenata* H.M.

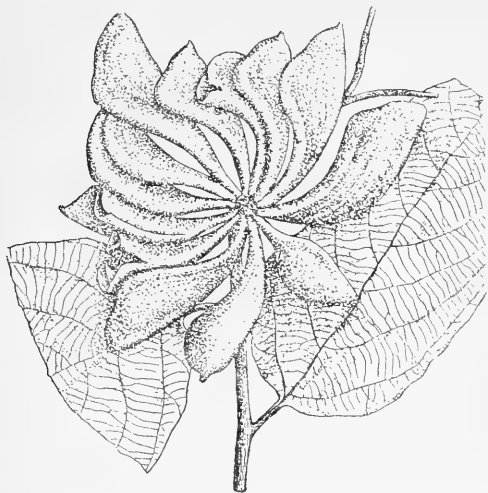


Fig. 4. Bark gall of *St. benzoin* DRYAND.,  $\times 7/8$ .

**2. *Styrax japonicum* SIEB. & ZUCC.** *Fl. Jap.* 1 (1835) 53, t. 23; *PERK. Pfl.R.* 30 (1907) 73.—*St. kotoensis* HAYATA, *l.c.* *Pl. Form.* 5 (1915) 121.—*St. philippinensis* MERR. & QUIS. *Philip. J.Sc.* 56 (1935) 313, t. 1.

Shrub 2–3 m. *Leaves* on long-branches alternate, ovate to ovate-lanceolate, sparsely stellate-lepidote to subglabrous and often with domatia in the nerve-axils below,  $4\frac{1}{2}$ – $9\frac{1}{2}$  by 2–6 cm; lateral nerves 4–5 pairs; petiole 4–7 mm. Pedicels 1– $1\frac{1}{4}$  cm, base densely lepidote, upwards sparsely so, thickened towards the calyx, drooping. *Calyx* campanulate, 4–5 mm high, stellate-lepidote. *Fruit* ellipsoid, apex truncate, mucronate, seed oblong, 3-sulcate, surface minutely pitted, 10–11 by 5–6 mm.

**Distr.** Japan, N. China, Riu Kiu and Formosa, in *Malaysia*: N. Philippines (Camiguin & Batan Isl., N. of Luzon), only twice found, apparently at low alt.

**Ecol.** *Fl.* in March, *fr.* in June.

**Notes.** A distinct northern type, here accepted as a slightly differentiated outlier of the *St. japonicum* population with somewhat larger flowers.

**3. *Styrax benzoin* DRYAND.** *Phil. Trans.* 77 (1787) II, 308; *PERK. Pfl.R.* 30 (1907) 59; *STEEN. Bull. J. B.B.* III, 12 (1932) 228; *BURK. Dict.* (1935) 2105.—*St. benzoë* BL. *Cat.* (1823) 6, *nomen*.—*St. benjoin* ROXB. *Fl. Ind.* (1832) 415.—*Lithocarpus benzoin* BL. *ex* ROYLE, III. (1839) 261, *in syn.*—*Plagiospermum benzoin* PIERRE, *Fl. For.* 4 (1889) 260.—*St. rauenensis* BOERL. *ms. ex* GRESH. *l.c.* 118.—**Fig. 2, 4, 5b.**

Tree 8–34 m, trunk 10–100 cm diam., buttresses

small or absent; bark wine-red in section, 3–7 mm, wood white. *Leaves* ovate to oblong or lanceolate, base rounded, apex acuminate, 8–13 by  $2\frac{1}{2}$ –5 cm; petiole sulcate 5–13 mm; nerves 7–13 pairs. *Flowers* fragrant, in 6–11 cm long panicles often forming a leafy panicle 13–20 cm long. Buds solid, blunt. Pedicels  $1\frac{1}{2}$ –4 mm, top-shaped. Corolla lobes 9–12 by 2– $3\frac{1}{2}$  mm, tube 1–2 mm high. Staminal tube  $2\frac{1}{2}$ –4 mm, anthers 5 and  $5\frac{1}{4}$  mm long. Ovary 8– $12\frac{1}{2}$  mm high. *Fruit* depressed-globose 2– $2\frac{1}{4}$  by  $2\frac{1}{4}$ –3 cm, indehiscent; pericarp (3–)4–5 mm diam., subtended by a rarely appressed calyx 7–13 mm diam. Seed 1(–2), *ca* 15 by 19 mm, dull pale brown; hilum 3–6 mm diam., in *var. hiliferum* 10–12 mm diam.

**Distr.** *Malaysia*: Sumatra (only the main land), Malay Peninsula and West Java (rare, mostly W of Buitenzorg), 10–1500 (mostly 100–700) m, doubtful from Banka Isl. Erroneously recorded from the Philippines by F. VILL, *Nov. App.* (1880) 27.

**Ecol.** In mixed primary forests, often common, mostly on fertile soils; *fl.* & *fr.* not periodic, Jan.–Dec. Germination preferably in the shadow. Several gall forms are described, all of the saccate type. The fruit is eaten by swine and deer.

**Uses.** Cultivated in Sumatra (mostly Palembang and Tapanuli Res.), Java (also in monsoon climate) and W. Borneo, often in clearings; therefore, the tree occurs frequently gregarious in old secondary forests. Sumatrans often soak the fruit before planting, or peel them. Yields red benzoin, mostly consisting of benzoic acid. Resin can be drawn from 7 years old saplings. Wood worthless.

**Vern.** (*Ke*)*menjan*, *hamindjan* or *kumajan*, with various spelling and with various additional names.

**Notes.** No specimens are known with certainty from the Indochinese Peninsula; those recorded belong mostly to *St. benzoides* CRAIB which differs in the absence of brown-stellate hairs, smaller flowers (lobes 8 by  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm) and different fruit (1 cm high with  $\frac{1}{2}$  mm thick 3-valved pericarp). This

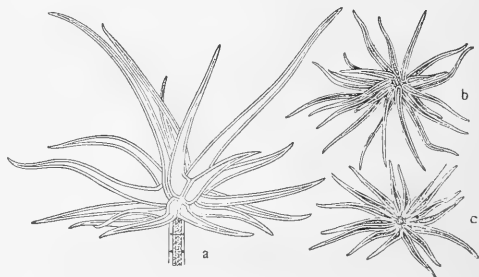


Fig. 5. Brown stellate hairs of a. *St. crotonoides* CLARKE, b. *St. benzoin* DRYAND., and c. scales of *St. parallelloneurum* PERK.,  $\times 160$ .

continental species produces Siam benzoë (*cf.* HOOK. *l.c.* Pl. t. 2999).

**var. hiliferum** STEEN. *l.c.*—Seed subglobose 17–18 by 20–24 mm. Testa dark-brown. Hilum 10–12 mm diam.—**Fig. 2.**

Distr. *Malaysia*: Malay Peninsula (Pahang) and Sumatra (Tapanuli).

Vern. *Kemanjan bukit* (Mal. Pen.), *hamindjan minjak* (Batak, Sum.).

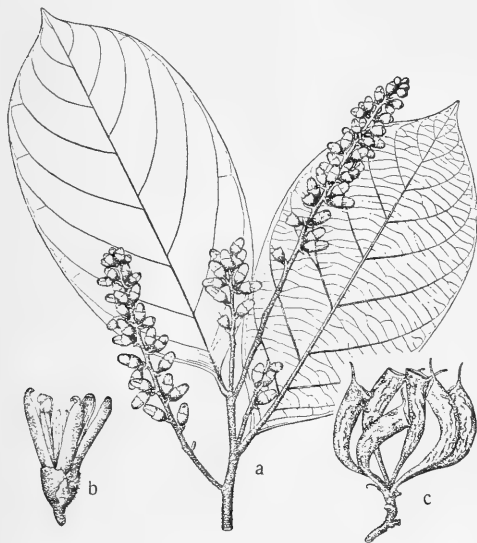


Fig. 6. *Styrox crotonoides* CLARKE,  $\times \frac{1}{3}$ , flower, nat. size, bunch of sack-galls,  $\times \frac{1}{3}$ .

4. *Styrox crotonoides* CLARKE, in HOOK.f. Fl. Br. Ind. 3 (1882) 589; STEEN. Bull. J.B.B. III, 12 (1923) 239; BURK. Dict. (1935) 2107.—Fig. 2, 5a, 6.

Tree 13–27 m by 25–50 cm. *Leaves* oblong to broad-elliptic, rarely subovate, base rounded, margin entire, apex acute-acuminate; nerves (7–)9–11 pairs, connected by transverse veins. Infl. mostly



Fig. 7. Spiral galls of *St. paralleloneurum* PERK., on a fruiting twig,  $\times \frac{2}{3}$ .

unbranched spike-shaped, rachis stout, straight, bearing fls from the base; fls solitary or in pairs. Pedicels  $\frac{1}{2}$ – $3\frac{1}{2}$  mm, rusty tomentose. *Calyx* 4–5 mm across. Corolla lobes 10 by  $2\frac{1}{2}$  mm, tube 1–2 mm high. Staminal tube 2 mm; filaments 1 mm; connective lepidote; anthers 5–6 mm. Style 6–7 mm. Mature fruit rusty tomentose.

Distr. *Malaysia*: Malay Peninsula, 50–300 m alt.

Ecol. Mixed primary forests on low hills. Umbellate rusty coloured sack-galls are described. As far is known it yields no benzoin.

5. *Styrox oliganthes* STEEN. Bull. J.B.B. III, 12 (1932) 241.—Fig. 2.

Tree up to 33 m, trunk 50–60 cm diam. *Leaves* ovate-oblong, rarely lanceolate, often oblique, base cuneate or rounded, apex blunt-acuminate, margin recurved s.s., 7– $9\frac{1}{2}$  by 3–4 cm; primary nerves 7–8

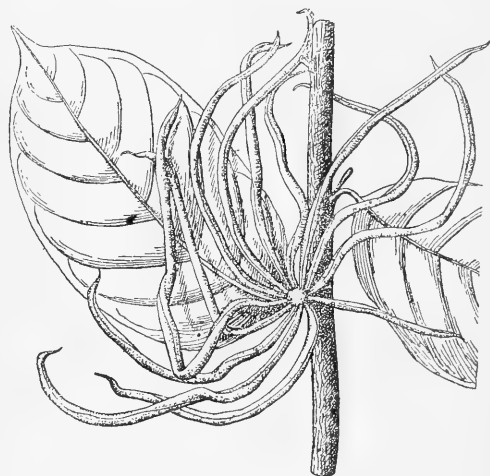


Fig. 8. Bark gall of *St. paralleloneurum* PERK.,  $\times \frac{4}{5}$ .

pairs; petiole  $3\frac{1}{2}$ –8 mm. *Flowers unknown*. *Calyx* in fruit  $3\frac{1}{2}$ –4 by  $6\frac{1}{2}$ – $7\frac{1}{2}$  mm. *Fruit* obovate not dehiscent, apex broadly rounded, short-mucronate, 10–13 by  $8\frac{1}{2}$ – $9\frac{1}{2}$  mm. Seed ovate, dull dark-brown, without papillae,  $9\frac{1}{2}$  by 6 mm; hilum 4 by 3 mm.

Distr. *Malaysia*: Sumatra (Eastcoast Res.), ca 500 m alt. Only once collected.

Ecol. Primary mixed forest, fr. Febr.

Notes. By its height, non-dehiscent fruit, pauciflorous infl. and not papillose seeds different from *St. tonkinensis* CRAIB. and *St. benzoides* CRAIB from continental Asia; the flowers may yield additional characters.

6. *Styrox paralleloneurum* PERK. Bot. Jahrb. 31 (1902) 484; Pfl.R. 30 (1907) 37; STEEN. Bull. J.B. B. III, 12 (1932) 243.—*St. sumatranus* J.J.S. Tect. 10 (1917) 204.—Fig. 2, 5c, 6–8.

Tree, 5–35 m by 23–60 cm; clear bole 6–25 m. *Leaves* ovate to lanceolate, mostly ovate-oblong,



Fig. 9. Spiral galls of *St. paralleoneurum* PERK.,  $\times 3/5$ . These twisted galls have essentially the same structure as sack-galls, and contain a cavity.

distinctly acuminate, 6–16 by  $2\frac{1}{2}$ – $6\frac{1}{2}$  cm; tomentum of undersurface thinner than in *St. benzoin* and not woolly, golden-brown lepidote; nerves 6–8 pairs glabrate, with distinct transverse veins, mostly cinnamon-coloured, petiole 7–15 mm. Larger infl. leafy, panicles 2–11 cm long. *Corolla* in mature buds  $2-4 \times$  as long as the calyx. Fls violet-scented, drooping, 4–6 mm stalked. Calyx  $3-4\frac{1}{2}$  mm high and slightly broader. Corolla 13–15 mm, tube  $4-4\frac{1}{2}$  mm; lobes 11–13 by  $3-3\frac{1}{2}$  mm. Stamens  $12-12\frac{1}{2}$  and 13–14 mm; filaments 9–10 mm; anthers 4–5 mm, margin of the cells lepidote. *Fruit*-base included by the cupular, fleshy, thickened calyx, shell 5–9 mm diam. hard-fleshy. Seeds 1(–2) ovate-globose, with broad base; testa shining, bony, dark-brown.

Distr. *Malaysia*: Sumatra (only main land) & Malay Peninsula, 575–1700 m.

Ecol. Primary mixed forests, rarely in secondary forest (old clearings), often common but scattered, mostly on slopes, sometimes on ridges. Habit as in *St. benzoin*, resembling nutmeg trees. Galls unique, spirally twisted sack-galls. *Fl.* mostly March–July, *fr.* July–Nov.

Uses. Wood of inferior quality. Tapping yields white benzoin chiefly consisting of cinnamic acid, in Sumatra (Tapanuli Res.) planted in clearings and secondary forests, in Java by the For. Serv.

Vern. (*Ke*)menjan, in different spellings and additional epithets, as in *St. benzoin*.

Notes. Very distinct from *St. benzoin*, and easily recognizable in the sterile state by the transverse veins and appressed scales on the underside of the leaves.

*f. inutilis* STEEN. *l.c.*—Tomentum of leaf undersurface tinged light brown, scales few; upper surface light brown to brown *s.s.*; benzoin said to be worthless.

Distr. Once found in Tapanuli, said to be removed from plantations.

Vern. *Kemenjan bulu* (also used for *St. benzoin*).

7. *Styrax ridleyanum* PERK. *Pfl.R.* 30 (1907) 61; STEEN. *Bull. J.B.B.* III, 12 (1932) 247; FISCHER, *Kew Bull.* (1937) 438.—*St. subpaniculatus* (non JUNGH. & DE VR.) BACKER *ex* HEYNE, *Nutt. Pl.* (1927) 1260, *in nota*; BURK. *Dict.* (1935) 2107.

Tree up to 30 m by 30 cm, buttresses up to 80 cm, clear bole 15 m. *Leaves* generally alternate, ovate to oblong-ovate, distinctly often abruptly acuminate, 7–17 by  $3\frac{1}{2}$ –8 cm; nerves 7–9 pairs; petiole  $\frac{1}{2}$ –1 cm long; axillary buds 3–5 mm long, brown-tomentose. Panicle leafy at the base,  $7\frac{1}{2}$ –20 cm long. *Flowers* fragrant. Corolla tube 2 mm high; lobes valvate or slightly induplicate-valvate, margin thickened, 9–10 by 3 mm. Stamens subequal, tube  $\frac{2}{3}$ –1 mm high; filaments  $1\frac{1}{3}$ –2 mm long; anthers 6– $6\frac{1}{2}$  mm, connective prominent and broadened above the cells. Style 8 mm. Stigma lobed to truncate or hammer-shaped. *Fr.* unknown.

Distr. Burma and *Malaysia*: Sumatra & Malay Peninsula, low alt.

Ecol. Apparently rare in lowland primary mixed forests.



Vern. *Kemenjan burong* (also for *St. benzoin*), *k. landak* (Mal. Pen.).

Notes. The nearest ally of *St. benzoin*, and only differing in the flowers, though the fruit will probably show additional characters when known. Not known to yield resin.

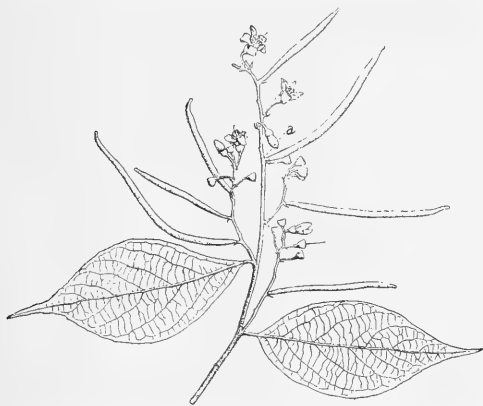


Fig. 10. Flower galls of *St. serrulatum* ROXB. var. *mollissimum* STEEN.,  $\times 1/2$ .

8. *Styrax serrulatum* ROXB. Fl. Ind. ed. CAREY 2 (1832) 415; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1882) 588, *p.p.*; STEEN. Bull. J.B.B. III, 12 (1932) 248.

No Malaysian specimen agrees entirely with the Indian ones, and I assume that the Malaysian specimens represent distinct varieties. It is a rather variable species and it is closely related to a group of allied species in SE. Asia: *St. grandiflorum* GRIFF., *St. caudatum* WALL., *St. hookeri* CLARKE, *St. virgatum* KURZ, all of them possessing a larger corolla; *St. japonicum* is distinct by drooping, long, glabrous pedicels and a glabrous calyx. The aestivation is variable, being subvalvate or imbricate in bud, even in one flower.

var. *rugosum* STEEN. *l.c.*—*St. serrulatum* auct. *p.p.*; GRESHOFF, Schetsen (1896) 118; GAMBLE, Mat. Fl. Mal. Pen. (1905) 251, *excl. fr.*; RIDL. Fl. Mal. Pen. 2 (1923) 296; BURK. Dict. (1935) 2107, *p.p.*—*St. porteriaum* WALL. Cat. (1828) no 4401, *nomen*; G. DON, Gen. Hist. 4 (1837) 5; DC. Prod. 8 (1844) 267; MIQ. Fl. Ind. Bat. 1, 2 (1859) 463; PERK. Pfl. R. 30 (1907) 77.—*St. floribundum* GRIFF. Not. Pl. As. 4 (1854) 287.—Fig. 2.

Small to medium tree up to 20 m. *Leaves* on both surfaces with scattered small stellate hairs, 5–11 by 3–5 cm; nerves 5–6 pairs. *Racemes* short, terminal on the shoots, or axillary in depauperate racemes or even solitary. *Corolla* lobes 10–11 by 4 mm. Filaments 5 mm, glabrous towards the apex; anthers  $3\frac{1}{2}$ –5 mm. *Style* 11–14 mm. *Fruit* ovate-to obovate-globose, pericarp rugose 2 mm diam. Seed 6–8 mm across; hilum 5 mm long.

Distr. ? India, Andamans, Mergui, Tenasserim and Malaysia: Penang Isl. and Malay Peninsula (Malacca, once).

Ecol. Mixed primary forests, up to 200 m. *Fl. fr.* March-May.

var. *mollissimum* STEEN. Bull. J.B.B. *l.c.*—*St. subpaniculatum* JUNGH. & DE VR. Pl. Nov. Ind. Bat. 1 (1845) 9; MIQ. Fl. Ind. Bat. 1, 2 (1859) 464, Suppl. (1860) 187; GRESH. Schets. (1896) 118; PERK. Bot. Jahrb. 31 (1902) 483; Pfl. R. 30 (1907) 72; BURK. Dict. (1935) 2107.—*Indet.* MIQ. Linnaea 26 (1853) 285.—*Hopea* sp. MIQ. *l.c.* Suppl. (1860) 492, in *adnot.*—*St. subdenticulatum* MIQ. *l.c.* 187, 474; GRESH. Schets. (1896) 118; PERK. *l.c.*; S. MOORE, J. Bot. (1925) Suppl. 65; v. D. MEER MOHR, Trop. Nat. 20 (1931) 158.—*Styrax* sp. DOCT. v. L. Bull. J.B.B. III, 4 (1922) 158; Zoocec. (1926) 457.—Fig. 2, 10–12.

Tree 10–30 m by 8–45 cm. *Leaves* stellate-pubescent to subtomentose on the lower surface, the parenchyma remaining visible, 7–14 by  $3\frac{1}{2}$ – $7\frac{1}{2}$  cm; nerves 6–8 pairs. *Flowers* in pyramidal brown-yellow tomentose panicles 5–17 cm long; lobes  $7\frac{1}{2}$  by  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm, pubescent all over, distinctly imbricate. Anthers  $2\frac{3}{4}$  and  $3\frac{1}{4}$  mm. *Style* 8–10 mm. *Fruit* obovate, not dehiscent; pericarp smooth  $\frac{3}{4}$  mm diam. Seed  $9\frac{1}{2}$  by 6 mm; hilum 3 mm long.

Distr. Malaysia: Sumatra, 350–1500 m alt.



Fig. 11. Alcorniform galls of *St. serrulatum* var. *mollissimum* STEEN.,  $\times 1/3$ .



Ecol. Scattered in primary mixed forests, *fl.* mostly Jan.-Febr., *fr.* mostly May-June. Three kinds of galls are known, *viz* coralliform, alci-corniform and siliqua-shaped ones (*cf.* V. D. MEER MOHR and DOCT. V. L.).

Uses. Once reported to yield benzoin used as incense.

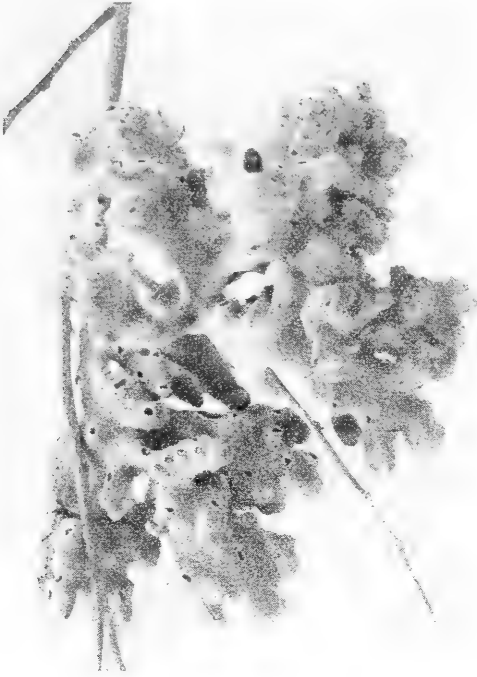


Fig. 12. Coralloid galls of *St. serrulatum* var. *mollissimum* STEEN.,  $\times 2/5$ .

#### Excluded

*Styrax ceramense* WARB. Bot. Jahrb. 13 (1891) 302 = *Diospyros*.

*Styrax ellipticum* JUNGH. & DE VR. Pl. Nov. Ind. Bat. (1845) 10; MIQ. Fl. Ind. Bat. 1, 2 (1859) 464, Suppl. (1860) 187; GRESH. Schets. (1896) 118; PERK. Bot. Jahrb. 31 (1902) 484; Pfl.R. 30 (1907) 86; STEEN. Bull. J.B.B. III, 12 (1932) 253.—I have not succeeded in locating the type specimen. It is certainly not *Styracaceous* and possibly belongs to *Xanthophyllum* or *Vatica*.

*Styrax glabratum* (non SCHOTT) WARB. *l.c.* = *Diospyros*.

*Styrax javanicum* BL. Bijdr. 13 (1825) 671 = *Alangium*.

*Styrax obovatum* RIDL. J. As. Soc. Str. Br. 61 (1912) 28 = *Symplocos*.

*Styrax rassamala* REINW. ex STEUD. Nomencl. ed. 2 (1841) 651 = *Alangium*.

*Styrax villosus* BL. Bijdr. *l.c.* = *Alangium*.

*Styracin*. gen. nov.? ZOLL. Syst. Verz. 2 (1854) 136 = *Vatica*.

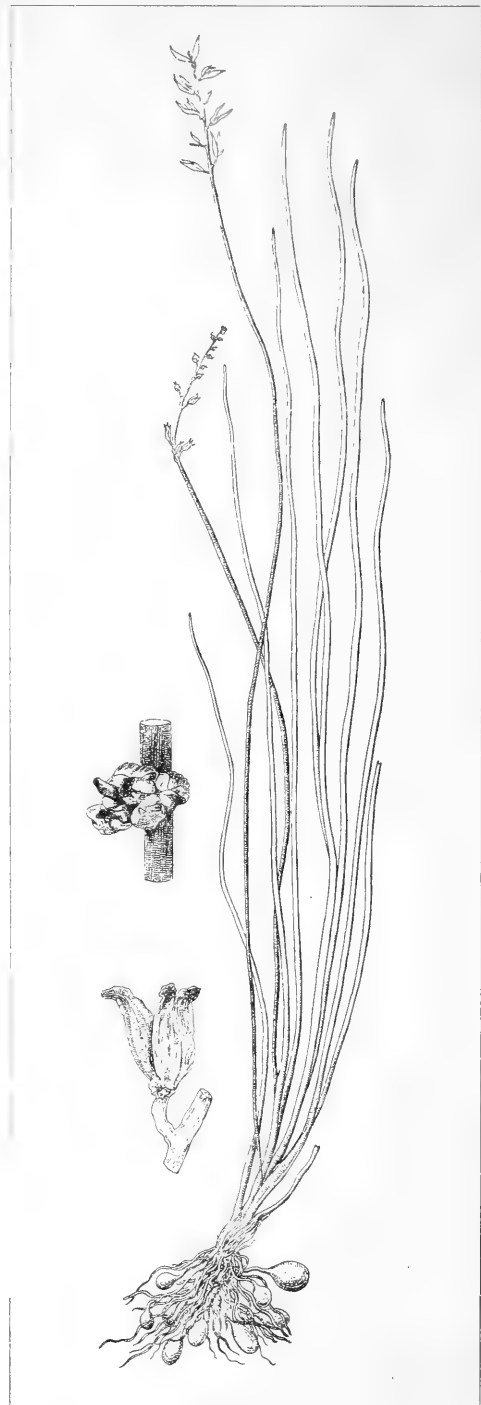


Fig. 1. *Triglochin procera* R.Br. var. *dubia* BTH. Habit,  $\times 2/5$ , flower and juvenile fr. enlarged.

# JUNCAGINACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. TRIGLOCHIN

LINNÉ, Sp.Pl. (1753) 338; BUCH. Pfl.R. 16 (1903) 7.—*Cycnogeton* ENDL. Ann. Wien. Mus. 2 (1838) 210; Gen. Suppl. 1. (1848) 1369; HUTCH. Fam. Fl.Pl. 2 (1934) 38; *pro sect.* BTH. Fl. Austr. 3 (1878) 165.

Glabrous, annual or perennial herbs. Leaves *distichous*, radical, entire, linear, with a sheath. Inflorescence terminal, spicate or racemose. Flowers bisexual, actinomorphic, small, inconspicuous, mostly green. Perianth segments 6, conchiform. Stamens 6 (or partly reduced), epi-tepalous. Anthers sessile, extrorse, cells 2. *Carpels* 6, or less by abortion, free or united, or partly free; ovule 1 per cell, basal, erect; style mostly absent. Pericarp dry. Seed exalbuminous, embryo straight.

Distr. Cosmopolitan, the majority of the *ca* 15 *spp.* known from the S. hemisphere. The Malaysian species is the only one of *subg.* *Cycnogeton* (ENDL.) BUCH., distinct by entirely free carpels.

Ecol. Predominantly in marshy localities, or in the water; some *spp.* in semi-arid countries.

Notes. The family is sometimes called *Scheuchzeriaceae*, but *Juncaginaceae* has priority. It centers in the S. hemisphere, specially in the S. Pacific. HUTCHINSON (Fam. Fl.Pl. 2 (1934) 36, 38) has removed *Scheuchzeria* from *Junc.* to a separate family in a separate order on account of bracteate pedicels.

Only one species is hitherto reported from Malaysia:

**1. *Triglochin procera* R.Br. var. *dubia* (R.Br.) BTH.** Fl. Austr. 7 (1878) 168; BUCH. Pfl.R. 16 (1903) 14; STEEN. J. Arn. Arb. 28 (1947) 419.—*T. dubia* R.Br. Prod. (1810) 343.—*T. linearis* ENDL. Pl. Preiss. 2 (1846/7) 54.—*T. procera* R.Br. var. *gracilis* MICHEL in DC. Mon. Phan. 3 (1881) 108.—**Fig. 1.**

Perennial, 30–50 cm long; rhizome short, roots partly thickened and ending in globular tubers 2–3 cm across. Culms terete, solid, sheaths at the base surrounded by the fibrous remains 1–2 cm long of the nerves of former leaves. Leaves  $\pm$  as long as the culms, 1–3 mm broad. Spike multiflorous, rather lax and relatively few-flowered,  $1\frac{1}{2}$ –2, in fruit up to 7 cm long. Flowers sessile, ebracteate, towards fruiting gradually pedicelled. Stamens 6, distinctly in 2 rows, 1 mm long, very broad, slightly shorter than the erect oblong  $1\frac{1}{2}$ –2 mm long tepals rounded at the apex. Carpels mostly 3, the slightly curved outwards directed stigmatic apices protruding distinctly above the anthers; stigmas large oblique, linear, grooved. Nuts mostly 3, rarely 4, or 1–2, small, 7–9 mm long, linear-oblong mostly subfalcate,  $1\frac{1}{2}$ –2 $\frac{1}{2}$  mm pedicelled, erect.

Distr. Australia and Tasmania to *SE. Malaysia*: Wassi Kussa area in S. New Guinea, at low alt.

*Triglochin* belongs to a series of (sometimes world-wide) spread genera, both occurring in Australia and Asia but absent or exceedingly scarce in Malaysia, as *e.g.*: *Aldrovanda*, *Alisma*, *Anagallis*,

*pumila*, *Astragalus*, *Callitriche*, *Eryngium*, *Glossostigma*, *Leptocarpus*, *Limonium*, *Oxalis*, *Parietaria*, *Philydrum*, *Plantago*, *Rothia*, *Tenagocharis*, *Tragus*, *Villarsia*, and *Zannichellia*.

Ecol. Savannah forest, common in streams which contain water only during the wet season, locally massed. Roots partly swollen into edible terminal tubers. Hardly an aquatic plant. Fl. Dec.–Jan.

Notes. The species is more robust than the variety: length  $\pm$  1 m, leaves 4–10 mm broad, spikes denser, gynoeceum less reduced. The variety moreover occupies a peculiar habitat, and seems to represent an ecotypic raiation. HUTCHINSON *l.c.* recognizes *Cycnogeton* as a separate genus by its free carpels; some other *spp.* of *Triglochin* occupy an intermediate position.

### Excluded

*Scheuchzeria palustris* MIQ. Ill. Fl. Arch. Ind. (1870) 48; MICHEL in DC. Mon. Phan. 3 (1881) 95; BUCH. Pfl.R. 16 (1903) 15; STEEN. Bull. J.B.B. III, 13 (1934) 221.—*Sch. asiatica* MIQ. Fl. Ind. Bat. 3 (1855) 243; Suppl. (1860) 35; KOORD. Exk. Fl. Java 1 (1911) 91.—In the Leyden Herbarium is a sheet of which the origin is doubtfully given as ‘? Java’, and said to be collected by KORTHALS. Interchange of labels is probably the cause of this erroneous record.



Fig. 1. *Trigonistrum hypoleucum* MIQ. Flowering twig,  $\times 2/3$ , a. flower, petals removed, b-c. petals, d. bag-shaped petal, e. the same, frontal view, f. fruiting tip of inflorescence, g. bracts with glands, h. winged partial fruit, i. opened, showing insertion of seed.

## TRIGONIACEAE (C. G. G. J. van Steenis, Buitenzorg)

### 1. TRIGONIASTRUM

MIQ. Fl. Ind. Bat. Suppl. (1860) 394; B. & H. Gen. Pl. 1 (1862) 139; MIQ. Ann. Mus. Bot. L.B. 1 (1863) 142, *in clavis*; BENN. in HOOK. f. Fl. Br. Ind. 1 (1872) 208; BAILL. Hist. Pl. 5 (1873) 91; KING, J. As. Soc. Beng. 59, II (1890) 133; Ann. R. Bot. G. Calc. 5, 2 (1896) 135, t. 159; BOERL. Handl. 1, 1 (1890) 78; CHODAT, Bull. Boiss. 3 (1895) 136; BARTH, *ib.* 4 (1896) 481; E. & P. Nachtr. (1897) 209; RIDL. Fl. Mal. Pen. (1922) 141; ENDERT, Med. Boschb. 20 (1928) 65; LEMÉE, Dict. 6 (1935) 704 *excl. syn.* *Factorovskya* EIG.—*Isopteris* WALL. CAT. (1832) no 7261, *nomen, ex B. & H. l.c.*

Tree, wood vessels mostly solitary. *Leaves* simple, spread (on lateral branches), penninervous, entire, margin and leaf tip glandular; upper epidermis often double and provided with mucilaginous cells; midrib sulcate above. Stipules caducous. Indumentum of simple hairs. *Flowers* actinomorphic, bisexual, in axillary and terminal panicles; bracts with glandular margin. Sepals 5, free, nerved as the petals are, unequal, imbricate. Petals 5, free, very unequal, imbricate; posterior saccate with reflexed emarginate limb, lateral spatulate, spreading, anterior oblique, keel-like together, including at their base the genitals; entrance of the sac with one fleshy hairy concave gland (easily breaking into 2 parts). Stamens 6 monadelphous, tube split posteriorly, eventually with some loose minute teeth, minute upper part of filaments free; anthers oval, slightly emarginate at the base, 2-celled, opening with one slit, gaping; exine (judging from boiled fls) reticulate. Ovary hairy, easily falling into 3 parts as does the simple style; stigma small punctiform. Ovule pendulous solitary. *Fruit* composed of 3 easily detaching samaras. Seeds (*n.v.*) elongate, shortly hairy, exalbuminous; radicle very short.

Distr. Monotypic, confined to *W. Malaysia*, wrongly credited to New Guinea by LEMÉE, *l.c.*

Wood anat. HEIMSCH, Lilloa 8 (1941) 132.

Notes. This genus, which is the single representative of the family in Malaysia, was mostly included in the *Polygalaceae*, and though differing in several respects from the 2 other neotropical genera of the *Trigon.* by its spread leaves &c. it seems mostly allied to *Trigon.* HALLIER f. suggested in passing<sup>1</sup> affinity with the *Rosac.-Chrysobal.* (1918) for which indeed some arguments could be advanced. In the herbarium it is sometimes confused with *Angelesia* which it resembles superficially in vegetative characters. It has also been compared with *Dichapetalaceae*. The glandular leaf margin, glandular-thickened leaf tip, sulcate midrib, and the indumentum are easy characters for distinction. The gland in the posterior petal could be interpreted both as a disk or as (a) metamorphosed stamen(s).

**1. *Trigoniasstrum hypoleucum*** MIQ. *l.c.*; BENN. *l.c.*; CHODAT *l.c.*; FOXW. Mal. For. Rec. 2 (1922) 216; RIDL. *l.c.*; BAKER f. J. Bot. (1924/6) Suppl. 7, 143; MERR. Pl. Elm. Born. (1929) 132; BURK. Dict. (1935) 2182; incl. *var. oliganthum cum var. viride* AIRY SHAW, Kew Bull. (1940) 253.—*Isopterys penangiana* WALL. *ex* BENN. *l.c.*—Fig. 1.

Small to moderate-sized tree 6–30 m by 14–50 cm; wood hard, yellowish, fine-grained; bark exuding a yellowish, later turning reddish, gummy juice. Innovations hairy. *Leaves* oblong with cuneate base, apex acuminate, glandular-thickened, often  $\pm$  spatulate; petiole 4–7 mm, stout, sulcate; blade 8–18 by 3–6 cm; upper side often with a metallic hue *s.s.*; lower side whitish by a very thin arachnoid appressed indumentum consisting of

twisted hairs, interspersed with sclerenchymatic longer hairs; margin with minute impressed glands; side-nerves *ca* 5–6, reticulations prominent on both sides. Panicle leafy, 20–40 cm, lower bracts leafy, upper ones linear acute. *Flowers* white, fragrant; anthers pale yellow. Buds whitish *s.s.* Sepals *ca* 2½ by 1½ mm, ovate, acute, hairy. Saccate petal-base *ca* 2 mm, sometimes compressed, reflexed part *ca* 2 by 2½ mm; base thickened; laterals unguiculate-spatulate, *ca* 3½–4 by 1½ mm; anteriors 4–5 mm long, oblique-oblong. Staminal tube 1 mm high, filaments over ¼ mm free; anthers *ca* ½ mm. Gland *ca* ¾ mm diam. Style 1½ mm glabrous. Ovary ½ mm high. *Samaras* pale or yellow green, connate over 1½–2½ cm, with straight inner side 2¼–3½ cm long and rounded or lozenge-

shaped outer side, 1-1<sup>3</sup>/<sub>4</sub> cm broad. Seed not seen.

Distr. *Malaysia*: Sumatra, Malay Peninsula (incl. P. Penang), Borneo (incl. P. Laut).

Ecol. Evergreen non-inundated rainforest, scattered up to 1000 m, but mostly below 300 m; at the highest altitude found in sandy rainforest, differing slightly by blunter thicker leaves; *fl. fr.* Sept.-June.

Uses. The wood is little estimated.

Vern. *kikir*, *mangkudor* (SE. Borneo), *kaju bras*, *tinggiran batu* (Palemb.), *tinga batu* (Asahan), *marajali*, *mata pasak*, *suginara* (Mal. Pen.), apparently no fixed name.

Notes. The seedling grows out of the wing; the cotyledons are epigaic; the 1st pair of leaves is opposite.

# COCHLOSPERMACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. COCHLOSPERMUM

KUNTH, Malvac. (1822) 6; DC. Prod. 1 (1824) 255; PLANCH. in HOOK. Lond. J. Bot. 6 (1847) 139, 294, 311; BOERL. Handl. 1, 1 (1890) 70; Cat. Pl. H. B. 1 (1899) 49; RIDL. Fl. Mal. Pen. 1 (1922) 252; PILG. in E. & P. ed. 2, 21 (1925) 316; STEEN. Bull. J.B.B. III, 13 (1936) 519; BACKER, Bekn. Fl. Java 4a (1942) no 83.

Trees (or shrubs), often deciduous, producing gum and an orange juice. *Leaves* spread, palmatilobed, often with domatia in the axils of the main ribs; stipules caducous. *Flowers* actinomorphic, bisexual, showy, mostly golden-yellow, paniculate or racemose. Sepals 5 imbricate. Petals 5, imbricate or contorted, emarginate. Stamens  $\infty$ , with free filaments, equal or subequal; anthers 2-celled, linear, basifixed, opening by introrse, short, often confluent pore-like slits. Ovary 1-celled with laminar placentas projecting into the cell, or perfectly or imperfectly 3-celled, the upper portion remaining 1-celled; ovules  $\infty$ , style simple, stigma punctiform. *Capsule* 3–5-valved, valves of the endocarp separating from and alternating with those of the pericarp. Seeds covered by woolly hairs, mostly cochleate-reniform; endosperm copious, rich in oil; embryo large, conforming to the shape of the seed; cotyledons broad.

Distr. *Ca* 15 spp., mostly in trop. and subtropical America, some in trop. Africa and SE. Asia, 3 species in N. Australia, rare in Malaysia; *G. gillivrayi* is possibly the only native Malaysian species.

LAM assumed the genus to belong to the 'antarctic' type (*Blumea* 1 (1935) 135), but it is manifestly peritropical.

Ecol. The species prefer a semi-arid or seasonal climate, and in Malaysia occur only in regions with a dry season. Some African species are fire-resistant through a corky layer on the rhizome.

Notes. The family was formerly often included in *Bixaceae*; HALLIER *f.* referred it to the *Tiliaceae* (Med. Rijksherb. 35 (1918) 18). Several authors describe the sepals of *Cochlospermum* as deciduous; in *C. religiosum* cultivated at Buitenzorg they are decidedly persistent. Domatia are not yet recorded in the genus but in cultivated *C. regium* at Buitenzorg they are present in the basal axils of the main ribs as tufts of hairs, and *Acari* were observed between them. The generic name is preserved against the few years earlier *Maximiliana* MART. & SCHRANK (1819).

### KEY TO THE SPECIES

1. Ovary pubescent. Stamens red in the lower half . . . . . 1. *C. regium*
1. Ovary perfectly glabrous. Stamens yellow.
2. Leaves entirely glabrous; lobes 5–7, incised for  $\frac{5}{6}$ – $\frac{7}{8}$  of the length of the main ribs, 6–7 by 2–3 cm. Fls  $\pm$  6–9 cm across. Stamens  $\pm$  1 cm long with blunt hardly tapering anthers 3–4 mm long, pore rounded-triangular . . . . . 2. *C. gillivrayi*
2. Leaves pubescent to tomentose beneath, midribs tomentose above. Blade incised to  $\frac{2}{3}$  of its length into 3–5 lobes, middle lobe  $\pm$  5–11 by  $4\frac{1}{2}$ –9 cm. Fls  $\pm$  12–14 cm diam. Stamens  $1\frac{1}{2}$ –2 cm long, anthers distinctly tapering to the acute apex 6–7 mm long, pore sagittate . . . . . 3. *C. religiosum*

1. *Cochlospermum regium* (MART. & SCHRANK) PILG. Notizbl. 8 (1924) 716; BACKER, *l.c.*—*Maximiliana regia* MART. & SCHRANK, Flora 2 (1819) 452; BAKH. v. d. BR. Bull. J.B.B. III, 6 (1924) 185.—*C. vitifolium* SPRENG. Syst. Veg. 2 (1825) 596; STEEN. *l.c.* 521.

Small tree 3–12 m, with red-brown branches. *Leaves*  $\pm$  orbicular, 10–30 cm wide, cordate, glabrous, incised to  $\frac{2}{3}$ – $\frac{3}{4}$ , lobes 5, acuminate, crenate-serrate, basal axils of main ribs with domatia; petiole 10–25 cm. *Flowers* in dense panicles at the end of leafless twigs, pedicellate, bright yellow. Sepals 5, tomentose, persistent. Petals obovate, 4–6 cm long. Stamens *ca* 2 cm, inner ones shortest; anther cells with a terminal pore. *Capsule* 5-valvate, partly green partly red, obovoid, 4–8 by 4–6 cm,

apex depressed, finely velvety pubescent, striate-nerved. Pericarp hard, endocarp cream-coloured, parchment-like. Seeds reniform covered with cotton-like white hairs.

Distr. Native in Central & South America, in Malaysia sometimes cultivated as an ornamental tree.

Wood anat. VESTAL, Philip. J. Sc. 64 (1937) 221.

Note. The ovary in *C. regium* is not 3-locular as is often suggested but imperfectly 5-locular.

2. *Cochlospermum gillivrayi* BENTH. Fl. Austr. 1 (1863) 106; F.v.M. Descr. Not. Pap. Pl. 1, 4 (1876) 54 (*gillevraei*); incl. *var. papuanum* BAKER *f.* J. Bot. 61 (1923) Suppl. 4; STEEN. Bull. J.B.B. III, 13 (1936) 522.

Small deciduous tree,  $4\frac{1}{2}$ –7 m, bark pale-grey,

channeled and scaly (BRASS); branches of the panicle, pedicels, and calyx slightly pubescent otherwise glabrous. *Leaves* 5–11 cm across, on 6–13 cm long petioles; stipules 3–4 cm long, subulate; blade divided to about  $1\frac{1}{2}$ – $1\frac{1}{2}$  cm from the base; lobes slightly toothed-crenate, 2 outer shortest and very acuminate. Panicles short and loose. *Flowers* yel-

3. *Cochlospermum religiosum* (L.) ALSTON, Handb. Fl. Ceyl. 6 (1931) 14; STEEN. Bull. J.B.B. III, 13 (1936) iv; CORNER, Wayside trees (1940) 174.—*Bombax religiosum* LINNÉ, Sp.Pl. (1753) 552; BAKH. v. d. BR. Bull. J.B.B. III, 6 (1924) 186.—*Bombax gossypium* (non L.) CAV. Diss. Bot. 5 (1785) 297, t. 156.—*C. gossypium* DC. Prod. 1



Fig. 1. *Cochlospermum religiosum* (L.) ALSTON, after the tree cultivated in the Bot. Gardens, Buitenzorg (type of *C. balicum*),  $\times 1\frac{1}{2}$ .

low; pedicels less than  $1\frac{1}{4}$  cm, lengthening after flowering. Sepals shortly pubescent, glabrous towards the apex, with very thin edges, outer sepals usually smaller than the inner ones. Anthers oblong, curved. *Capsule* obovoid-oblong, rarely exceeding  $7\frac{1}{2}$  cm, depressed-truncate. Seeds enveloped in fugacious wool.

*Distr.* N. Australia, N. Queensland, Thursday Island and other islands near N. Australia, in *Malaysia*: only known from the Port Moresby area, Terr. of Papua, sometimes planted there, also near Boku (Kemp Welch river area).

*Ecol.* Mostly in anthropogenic localities but apparently native, common on dry rocky places along the coast, *fl.* July–Sept.

(1824) 527; STEEN. Bull. J.B.B. III, 13 (1936) 522.—*Bombax conga* BURM. f. Fl. Ind. (1768) 145.—‘*Bombax lobatum*’ DESCHAMPS MS., Brit. Mus. t. 57.—*C. balicum* BOERL. Cat. pl. Hort. Bog. 1 (1899) 49.—**Fig. 1.**

Small rather crooked-branched, more or less deciduous tree. *Leaves* cordate,  $7\frac{1}{2}$ –20 cm diam., margin undulate or obscurely crenate, apex of the lobes acuminate with blunt tip; petiole articulated 8–25 cm long. Stipules linear-subulate, caducous, 7–8 mm long. *Flowers* in a simple raceme or a loosely branched panicle, terminal, short-hairy, one flower open at a time on each branch, facing side ways. Pedicels  $\pm$  2 cm long. Bracts caducous, triangular-acute, short-hairy, 4–5 mm broad at the

base. Corolla yellow, with a distinct odour. Sepals partly purplish,  $2-2\frac{1}{2}$  by  $1-2\frac{1}{4}$  cm. Petals thickened at the base. Stamens slightly S-curved, unequal. Anthers orange, falcate, 1 mm broad. Ovary globular. Style glabrous  $1\frac{1}{2}-2$  cm. Capsule obovate, 5-7 cm long, valves striate-ribbed,  $2\frac{1}{2}-3$  cm broad. Seeds reniform to cochleate, brown, 5-6 mm across.

Distr. India, Cambodia, introduced in Siam and Ceylon, in *Malaysia*: Penang Island and Malacca, E. Java and Bali, doubtless introduced.

Ecol. More or less established in Penang and very conspicuous in cultivated ground round the town, near Dato Kramat growing in a native settlement, in Malacca GRIFFITH noted 'near a stream at the foot of . . . hill'; in N. Bali near a large pagode (TEYSMANN) *pr.* Singaradja. At Buitenzorg flowering throughout the year. In Penang noted as deciduous. All specimens at low alt. It is propagated by cuttings or rather loppings; any branch stuck in the ground will strike in wet weather. Flowers last for  $1\frac{1}{2}$  day. If the flower is setting fruit the withered petals remain for a long time (CORNER).

Wood anat. By GAMBLE the wood is defined as 'extremely soft' (Indian Timbers 1902; here also short hand lens description).

Vern. *Bebaru* (Penang), *tjanigarah* (Bali), *buttercup tree*, *yellow cotton-tree*, *yellow silk cotton-tree* (Engl.). The Malay name '*bebaru*' is used in confusion with *Hibiscus tiliaceus*.

Notes. Certainly introduced in Penang, never re-collected in GRIFFITH's spot. Among the MS.-plates left by DESCHAMPS no 57 is unmistakably this species, which has never been re-collected in Java after DESCHAMPS figured it ( $\pm 1793-1802$ ); acc. to his MS. he did not visit Bali Island. The locality near Singaradja was visited by Mr DE VOOGD in 1936; flowering material was collected near the pagodes. The late Mr KERR wrote me, Aug. 1936, that 'there is no good evidence that the species is indigenous in Siam; the only place is a small hill crowned by a small deserted temple where it may quite well have been planted'. In India it is often used as a temple plant, and flowers are used in offerings. In Ceylon TRIMEN found it in the dry districts, but it occurs usually near temples for the sake of its beautiful flowers. For these reasons I am convinced that the species is introduced in *Malaysia*, that its introduction is due to its religious fame in India, and that it has been brought to Bali by the Hindus.

BOERLAGE described the Balinese specimens erroneously as having subglabrous leaves.



# ZYGOPHYLLACEAE (C. G. G. J. van Steenis, Buitenzorg)

## 1. TRIBULUS

LINNÉ, Sp.Pl. (1753) 386; STEEN. Bull. J.B.B. III, 13 (1933) 104; BACKER, Bekn. Fl. Java 4a (1942) no 66.

Prostrate hairy herbs. *Leaves* opposite, paripinnate, mostly anisophyllous; stipules present. *Flowers* actinomorphic, 5-merous, bisexual, solitary on pseudo-axillary peduncles, white or yellow. Sepals 5, free, imbricate, persistent or caducous. Petals 5, free, patent, imbricate, fugacious. Disk present. Stamens 10, subequal or unequal; anthers dorsifixed. Ovary superior, sessile, hairy, 5-12-lobed, 5-12-celled; style short and thick, with 5-12 decurrent stigmas; cells with 3 or more ovules. *Fruit* 5-angled or 5-12-winged; cocci partly abortive, spinous or tuberculate, indehiscent with 3-5 superposed seeds separated by septa.

Distr. & Ecol. *Ca* 20 spp. difficult to delimit, specially developed in the dry regions of Africa and Australia. In S. Africa the spinous fruits adhere to the wool and feet of sheep ('hoof-burs') and are a nuisance. The family has about 26 genera, of which 12 monotypic, and *ca* 250 spp., mostly of warm dry countries. In Malaysia one genus and one species.

1. *Tribulus cistoides* LINNÉ, *l.c.*; CHAM. Linnaea 5 (1830) 44; STEEN. *l.c.* p. 105; DE VOOGD, Trop. Nat. 26 (1937) 162; MERR. & PERRY, J. Arn. Arb. 21 (1940) 511.—? *T. terrestris* (non L.) THUNB. Flor. Jav. pt 2, cur. WIDMARK (1825) 13.—*T. terrestris*

Sepals narrow-lanceolate, acute, appressed-hairy, 7-11 mm long, caducous. Petals obovate-cuneate, apex broadly rounded-truncate, 1-2 by 1-1½ cm. Stamens subequal; anthers ± 1 mm long. Disk represented by 5 small erect scales appressed to the hirsute ovary, alternating with its lobes. *Cocci* 4-5 with sharp stout spines, two lateral largest; pericarp rather thick, corky.

Distr. Circumtropically ubiquitous, in *Malaysia*: confined to the E. part (fig. 2), avoiding the everwet Sunda Land; in some places, near harbours, probably an alien.

Ecol. In Malaysia exclusively indigenous along sand beaches and coastal dunes, locally often gregarious, fl. March-July.

Notes. Closely allied to *T. terrestris* L., an annual or biennial with much smaller flowers.

### Excluded

*Fagonia montana* MIQ. olim in sched. Herb. Metz, MIQ. Fl. Ind. Bat. 1, 2 (1859) 596, in syn.; CLARKE, in HOOK. Fl. Br. Ind. 3 (1882) 620; BOERL. Handl. 1 (1890) 147 = *Azima sarmentosum*. Though MIQUEL mentioned the name in his Flora, the specimen on which it was based is extra-Malaysian.



Fig. 1. *Tribulus cistoides* L., on the beach of Nusa Penida, near Bali. (DE VOOGD)

var. *moluccensis* BL. Bijdr. *l.c.*; MIQ. *l.c.* 682; FORBES, Wand. (1885) 501.—*T. moluccanus* DECNE, Herb. Tim. Descr. (1835) 118.—*T. lanuginosa* (non L.) THUNB. *l.c.*; BLANCO, Fl. Filip. (1837) 350.—*T. macranthus* HASSK. Flora 48 (1865) 403.—Fig. 1, 2.

Perennial herb, branches decumbent, apex ascending, 30-145 cm long; tap-root very long. *Leaves* of each pair: one 6-7- the other 4-5-jugate, 2-7½ cm long, midrib ending into a small mucro ½-2 mm long. Leaflets subsessile, base obliquely rounded-cordate, apex blunt to subacute, 6-22 by 2½-9 mm, both surfaces silky. Stipules falcate, acuminate, erect, 3-6 mm long. *Flowers* inserted laterally of the axil of the smallest leaves, bright yellow, 2½-4 cm diam.; pedicels hairy, 2-4 cm.

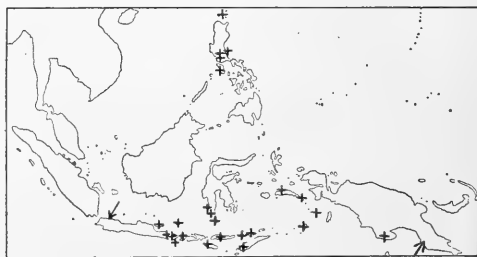


Fig. 2. Localities of *Tribulus cistoides* L. in Malaysia; an arrow indicates a presumably introduced occurrence.

## PODOSTEMACEAE (C. G. G. J. van Steenis, Buitenzorg)

Mostly annual, rather small, of peculiar habit, often moss-like, gregarious, confined to swift running water in streams and cascades. Tissues with silicium. Roots often thallose, flat, stem sometimes absent. *Leaves* mostly alternate, sometimes scattered, decussate or distichous, base often provided with a sheath, and sometimes stipule-like appendages, often dentate or divided. *Flowers* terminal, often in cymose inflo., mostly ♂, actinomorphic to zygomorphic. Perianth of 3–5 free or subconnate tepals, if reduced to two small, ovate or linear appendages, the bud is enveloped by an originally closed thin 'spathella'. Stamens hypogyn, 1–∞, often 2 unilateral, frequently monadelphic. Anthers mostly introrse, 2–4-locular, splitting lengthwise. Pollen grains single, or in twos or fours. Ovary superior, ovate to elliptic, mostly 2-, rarely 3-locular with thickened central placenta and thin septa. Ovules ∞; styles as many as carpels, free, rarely 1. *Capsule* septicid (often) ribbed; seeds ∞, minute, exalbuminous, epidermis mucilaginous.

Distr. Principally confined to the tropics throughout the world, not yet recorded from the Pacific islands and the greater part of Australia, northward as far as S. Japan, in Malaysia apparently very rare. The locality closest to Malaysia is isthmian Siam where Dr A. KEITH found *Podostemon ?algaeformis* BTH. in the nineties.

Ecol. All members of this aberrant stream-resistant family are confined to swift not too densely shaded streams with normally clear water. The rather numerous SE. Asiatic members are all tiny to minute plants growing socially and covering the rocks in sheets. During the rainy season they are mostly found only in the sterile thallose state and submerged. In the dry season the flowers appear and the thallus withers. They occur often very locally, and the plants are easily overlooked. Many additional records may be expected. Local dispersal is certainly effected by water; *Cladopus* seedlings have been found on rocks, a cemented dike, bamboo and an iron pipe at highwater mark. Dispersal from one river system to another unconnected is still obscure (birds, fishes, insects?). Transplanting experiments which I did with rocks covered by *Cladopus* from Mt Gedeh on Mt Salak in W. Java, were unsuccessful (1937). So were CIFERRI's in the Dominican Republic (Atti Ist. Bot. G. Briosi e lab. Crittog. Ital. Univ. Pavia V, 7 (1946) 18–21).

Notes. The affinity of the family is still uncertain; opinions are offered of alliance to *Saxifragaceae*; ENGLER accepts it to represent a separate Group *Podostemales* in the neighbourhood of the *Urticales*.

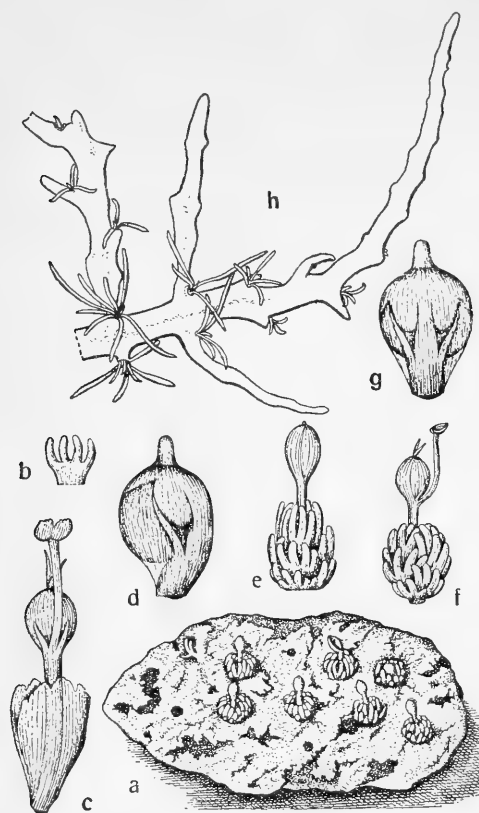
### KEY TO THE GENERA

1. Flowering stems very short, hardly 1 cm. Leaves crowded, scattered, imbricate, digitately lobed  
1. **Cladopus**
1. Flowering stems elongate, 2½–6½ cm. Leaves distichous, laterally compressed, entire, the upper 3–(4)-dentate . . . . . 2. **Torrenticola**

### 1. CLADOPUS

H. MÖLL. Ann. Jard. Bot. Btzg 16 (1899) 115; STEEN. Bull. Jard. Bot. Btzg III, 13 (1936) 530 (*lit.*).

Small, flatly adhering to the substratum. Roots flat, ligulate, without stomata, side-branches mostly opposite, at last conerescent in a crust on the substratum. Leaves of the sterile sessile sprouts (? roots) partly linear partly digitate with 4–7 segments as are those of the fertile stems. Flowering stems minute, hardly 1 cm in length, densely covered with scattered, imbricate, digitately lobed leaves. Flowers solitary, pedicellate, zygomorphic, before anthesis enclosed in an oblique spathella; spathella oval-acuminate, apex nipple-shaped, mostly irregularly dehiscing, sometimes slit on one side. Tepals 2, narrow triangular to linear, at both sides of the base of the filament. Stamen 1 (rarely 2 ?), anther basifixed, cells divergent at the base, filament curved; pollen grains 2-celled. Ovary smooth, oblique-ellipsoid, as long as the filament, curved towards the anther. Capsule oblique-ellipsoid, smooth, the largest valve persistent.



Distr. S. Japan (Kyushu), *Malaysia*: Java and SW. Celebes.

Ecol. Swift running streams and cascades, clinging to the rocks, also found on a cemented dike and occasionally young plants on bamboo, 5–1550 m.

Notes. The Japanese species *C. japonicus* IMAMURA belongs in my eye doubtless to *Cladopus* and does not represent a separate genus (*Lawiella* KOIDZ.). Specifically it differs in 8–12-lobed leaves.

**1. *Cladopus nymani* H. MÖLL., *ll. cc.*—Fig. 1.**

Roots dark green often reddish tinged, densely branched at last forming a continuous conrescent sheet exceeding 60 cm diam., branches opposite or alternate,  $\frac{1}{2}$ –3 mm broad, tips with a minute dorsal root cap. Sterile leaves in rosettes, simple or digitate, narrow 2–6 by  $\frac{1}{6}$ – $\frac{1}{3}$  mm. Fertile stems at the root margins, up to 5 mm long, leaves with 3–7 segments  $\frac{1}{4}$ –1 mm long. *Spathella* ca. 2 mm. Tepals narrow linear acute, 1 mm long. Stamens 1, rarely 2, anthers  $\frac{3}{4}$ –1 mm long. Ovary 2-locular ca.  $1\frac{1}{2}$  by 1 mm, stigmas 2, oblique,  $\frac{2}{3}$  mm long. *Capsule* smooth  $1\frac{1}{2}$ – $1\frac{3}{4}$  by 1 mm; pedicel 2–3 mm.

Distr. *Malaysia*: W.–E. Java, SW. Celebes, 5–1550 m.

Ecol. See under the genus.

Fig. 1. *Cladopus nymani* MÖLL., a. piece of rock with fruiting plant,  $\times 2$ , b. leaf,  $\times 4$ , c. open flower with dehiscent spathella,  $\times 6$ , d. bud, lateral,  $\times 6$ , e. stem in fruit,  $\times 4$ , f. flowering stem,  $\times 4$ , g. bud, dorsally,  $\times 6$ , h. sterile root system, juvenile plant,  $\times 3$ .

## 2. TORRENTICOLA

DOMIN, *nom. prov.* Bibl. Bot. 89, 2 (vol. 20) (1925) 149, t. 35, f. 7–13; ENGL. in E. & P. ed. 2, 18a(1935) 484; STEEN, J. Arn. Arb. 28 (1947) 421.—*Podost. indet.* F. v. M. Syst. Cens. (1882) 23; 2nd Cens. (1889) 166; BAIL. Compr. Cat. (1913) 417.—*Podostemon* sp. DOMIN, *l.c.*, *nom. alt.*—Fig. 2.

Roots lingulate, sparsely ramified; sprouts very close, erect, mostly simple rarely branched, thin, rigid, densely foliate. *Leaves* distichous, equitant, base laterally compressed, obtriangular, upper ones toothed, minute, thick, 1–2-carinate, decurrent, lowest semi-amplexicaulous, blade  $\pm$  patent. *Flowers* single, apical, strongly asymmetric. *Spathella* sub-oblique, tipped, irregularly circumscissile-dehiscent. Flower shortly stalked. Tepals 2, narrow, small. Stamen 1, articulate with the pedicel, in bud appressed to the ovary, filament broad, anther broad, connective emarginate, cells introrse. Pollen grains 2-celled. Ovary  $\pm$  globular, smooth, 2-locular with 2 grooves where the dissepiment is attached; stigmas 2, oblong-lanceolate, in bud appressed to the ovary towards the stamen. *Fruit* slightly oblique, terete, the largest valve persistent, ribs 10, indistinct. Placenta globular, surrounded by a thin narrow membranous dissepiment, caducous. Seeds numerous sub-angular oblong.

Distr. Monotypic, Queensland and *Malaysia*: SE. New Guinea.

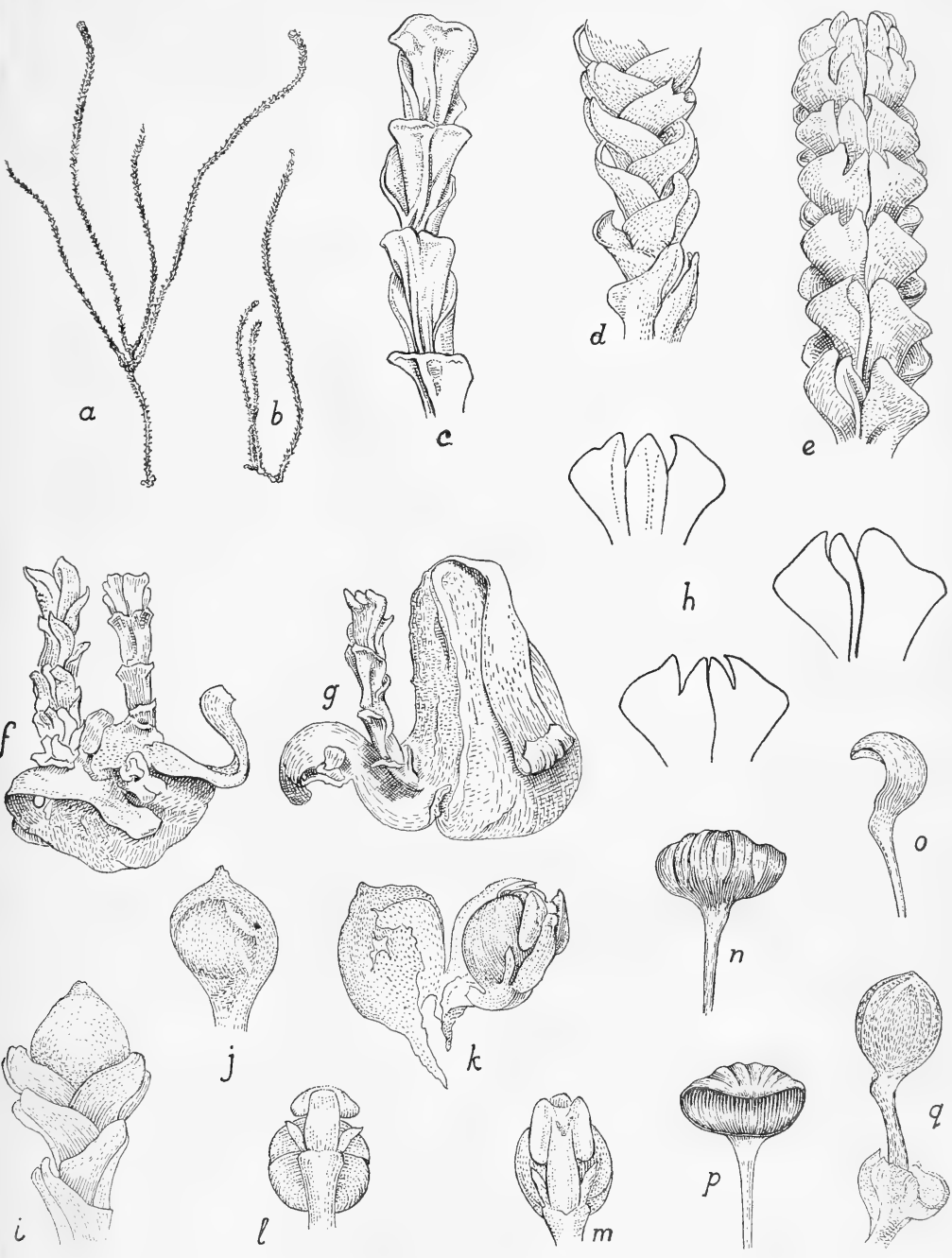


Fig. 2. *Torrenticola queenslandica* DOMIN. a-b. branched and unbranched stems, c. lower part of stem, d. central part, e. upper part, f-g. stem-bases attached to lingulate roots on pieces of gravel, h. leaf types, i. bud on apex of stem, j. closed spathella with bud, k. spathella opened artificially, l-m. dorsal view of flower, n-p. larger valve of fruit, q. unopened fruit. (a-b,  $\times \frac{3}{4}$ , c-q,  $\times 9$ ).

Notes. The first specimens were found in Queensland, Johnstone river, by WALTER HILL, in 1873; they remained a long time undescribed; OLIVER sent the specimens in 1874 to WEDDELL who recognized the species as new but could not place it. The New Guinean material exactly matches DOMIN's description. The floral structure is described here for the first time. Though manifestly distinct in the lingulate roots and in phyllotaxis, the closest ally is difficult to find, as there are several genera of which the flower-structure is very similar (*Cladopus*, *Polypheurella*) but their vegetative structure differs widely from that of *Torrenticola*. Vegetatively some *Podostemon* species from America are similar. Decussate leaves are found in *Willisia* from the Anamalais, but this genus possesses an androphore with 2 stamens. The tipped spathe *Torrenticola* has in common with *Cladopus*. For these reasons it stands more or less isolated and apparently represents a separate genus. Between the pollen grains I found globular bodies 1/10th the length of the grains, measuring about 3  $\mu$ . They were sometimes in twos. I accept these to represent sterile pollen grains.

1. *Torrenticola queenslandica* DOMIN, l.c.; ENGLER, l.c.; STEEN, l.c.—*Podostemon* sp. DOMIN, l.c. nom. altern.—Fig. 2.

Roots ca  $\frac{1}{2}$ –2 mm broad. Stems  $2\frac{1}{2}$ –6 $\frac{1}{2}$  cm long, densely set, darkgreen. Leaves ridged on the back, ca.  $\frac{1}{2}$ –2 mm long. Spathe  $\pm$  sessile, to  $\pm \frac{1}{2}$  mm stalked,  $\pm$  2 mm long. Pedicel  $\frac{1}{2}$ –1 $\frac{1}{4}$  mm in bud, 2 mm in fruit. Tepals  $\pm \frac{1}{2}$  mm long, filament  $\pm \frac{1}{2}$  mm long, thecae  $\pm \frac{3}{4}$  mm, cells slightly unequal, pollen grains  $\pm$  30  $\mu$ . Ovary 1 $\frac{1}{4}$  mm diam.; stigmas  $\pm \frac{1}{2}$  mm; seeds ca  $\frac{1}{4}$ – $\frac{1}{3}$  mm diam.

Distr. Queensland and Malaysia: SE. New Guinea, Roona (Laloki river), c. 200 m alt.

Ecol. On submerged rocks in the river (May 1935, CARR 12415). The stems and leaves were attacked by a fungus forming brown spots.

#### Excluded

*Lemnopsis major* ZOLL. Syst. Verz. 1 (1854) 75, 86, acc. to BACKER, Handb. Fl. Java pt 1 (1925)

59 (ZOLL. 3430) = *Halophila ovalis* HOOK. f. *Lemnopsis minor* ZOLL. *ibid.* (ZOLL. 3334) = *Halophila ovata* GAUD.

*Lemnopsis mnioides* ZIPP. Flora 12 (1829) I, 285; Alg. Konst- & Letterbode 1 (1829) 297, acc. to HALLIER f. Med. Rijksherb. Leiden 1 (1910) 40 = *Utricularia orbiculata* WALL.

*Tristicha bifaria* PRESL. Rel. Haenk. 1 (1827) 86 is suspected to represent *T. hypnoides* SPR. and was erroneously recorded from the Philippine Islands acc. to MERRILL (Philip. J. Sci. 10 (1915) Bot. 189).

Sp.: D'ALBERTIS, 'What I did and what I saw' 2 (1880) 93 mentions a plant which he found June 17, 1876 in the Fly River (STEEN, l.c. 1947) which was advanced by LAM (Blumea 2 (1936) 117) as a possible representative of the *Pod.* in New Guinea; the record will remain doubtful as no material was collected.

BECCARI Plant. Sum. 482 in herb. Kew (STEEN, 1936, l.c.) = *Aneura tamariscina* STEPH. (Hepaticae).

## AMARANTHACEAE (C. A. Backer, Heemstede)

Herbs, rarely climbing or clambering shrubs. *Leaves* opposite or alternate, exstipulate, simple, entire or obsoletely dentate-serrate. *Flowers* ♀, unisexual, or partly difformed and neutral, in clusters, heads, racemes, spikes or panicles, solitary or clustered in the axil of persistent bracts, usually bibracteolate. *Tepals* 3–5, mostly free; bracts, bracteoles and tepals with scarious margins or entirely scarious; bracteoles falling off with the perianth or persistent; perianth usually enclosing the fruit and falling off with it, rarely persistent. Stamens as many as petals and opposed to them, rarely fewer; filaments free, or connate below, or almost entirely united in a cup or tube, with or without interposed dentiform, subulate, linear or short and broad pseudo-staminodes; anthers dorsifixed or inserted in a basal cleft, 1–2-celled (2- or 4-locellate). Ovary superior, 1-celled; ovules 1 or more, basal; funicles short or long. *Fruit* sometimes baccate or crustaceous, usually membranous, very rarely corky, circumscissile, indehiscent or bursting irregularly. Seeds 1–∞, often lenticular or subreniform, smooth or verruculose.

Distr. Worldwide, more than 60 genera and *ca* 850 *spp.*, few in the tropical forests, most developed in America and Africa, in Australia a big centre of *Ptilotus*. In *Malaysia*: mostly represented by widely distributed anthropochorous *spp.*, none endemic, several naturalized.

The floristic areas occupied by the native *spp.* can be divided into three types *viz* wides, Western and Eastern elements. The wides are those of *spp.* widely distributed in the Old World. Their native country is often unknown.

The Western element (Asiatic or/and African) is represented by: *Aerva curtisii*, *Nothosaerva brachiata* (doubtful), *Digera muricata*, *Pupalia lappacea*, and is mostly confined to the western half of *Malaysia*.

It is about as strong as the Eastern (or Australian) element which consists of: *Gomphrena canescens*, *G. tenella*, *Ptilotus conicus*, *Deeringia arborescens*, *Amaranthus leptostachyus* & *A. interruptus*. This eastern element is for the greater part confined to New Guinea, the Moluccas, and the Lesser Sunda Islands.

Ecol. Mainly annuals of open places, in *Malaysia*: mostly in anthropogenic localities, waste places, road-sides, fields, two aquatic (*Centrostachys*, *Alternanthera philoxeroides*), one occasionally so (*Alternanthera sessilis*), a few almost exclusively in forests.

Uses. Some *spp.* are used as vegetables, especially *Amaranthus*. There are some ornamentals (*Celosia*, *Alternanthera*, *Gomphrena*, *Iresine*, *Amaranthus*). Several are medicinal. *Alternanthera ficoidea* var. *bettizickiana* is used against soil wash. Ashes of *Achyranthes aspera* are rich in alcali.

Notes. Flowers and ripe fruits are necessary for identification. The foliage, in many *spp.* is very variable and hardly offers constant characters for specific distinction. The species are, apart from the shape of the leaves, not very variable; *Amaranthus tricolor* and *A. lividus* are exceptions. *Celosia argentea* and some other species have produced varieties in breeding; these are sometimes unstable.

Figs. 2–3, 5–8 *courtesy* Pasuruan Exp. Station.

### (ARTIFICIAL) KEY TO THE GENERA

1. Leaves alternate.
2. Scandent or clambering shrubs, unarmed, green-leaved, at least 2 m tall, often very much larger. Flowers singly or clustered along the rachis of simple or paniced racemes or spikes, ♀ or unisexual, glabrous, white, yellowish or greenish, 1½–2½ mm long; filaments at their base united in a cup, without intervening pseudo-staminodes; stigmas 2–4, mostly 3, patent or recurved. Fruit an indehiscent berry falling out of the persistent perianth when ripe . . . . . 1. *Deeringia*
2. Otherwise.
3. Fruits all or for the greater part 2–∞-seeded. Flowers ♀ in simple or paniced (sometimes coxcomb-like) spikes, glabrous. Stamens 5; filaments at their base united in a cup. Erect, unarmed herbs or undershrubs.
4. Style 1, rather long; stigma 1, capitate. Perianth 6–10 mm long. Fruit membranous, circumsciss; seeds 1–9 . . . . . 2. *Celosia*
4. Style very short or absent; stigmas 2–3, linear-clavate. Perianth less than 4 mm long. Fruit baccate, falling out of the persistent perianth when ripe; seeds 10 or more, usually more than 20 1. *Deeringia*
3. Otherwise. Fruit 1-seeded.
5. No pseudo-staminodes.
6. Flowers ♀. Style 2–3 mm long; stigmas 2–3. Unarmed.
7. Flowers in short, dense head-like spikes. Lower flowers not accompanied by 2 palmatifid scales (sterile flowers). Filaments at their base connate in a cup. Stigma 1, entire or faintly 2-lobed. Fruit thin-walled.

8. Tepals distinctly dimorphous: 2 outer ones elliptic, their bases externally with a dense tuft of hairs; 3 inner ones with a narrow cuneate claw and patent ovate-oblong blade. Fruit indehiscent . . . . . 12. *Ptilotus*
8. Tepals subequal. Fruit circumsciss. Seed arillate . . . . . 3. *Allmania*
7. Flowers in spiciform often long racemes, the lower part of the older racemes lax. Lower flowers usually accompanied by 2 palmatifid scales (sterile flowers). Filaments free. Stigmas 2, recurved. Fruit crustaceous, indehiscent. Seed exarillate . . . . . 5. *Digera*
6. Flowers unisexual, in sessile (♂) (♀) or (♂♀) clusters; these either collected in a spike or panicle or not. Filaments free. Style very short or absent; stigmas 2-4 (often 3), linear. Unarmed or spinous. . . . . 4. *Amaranthus*
5. Filaments alternating with subulate pseudo-staminodes. Flowers ♂ or ♀, in the latter case long-pilose outside. Style very short, stigmas 1-2, minute . . . . . 8. *Aerva*
1. Leaves, at least partly, opposite.
9. Lower flowers not accompanied by fascicled hooks (difformed flowers).
10. Flowers in panicle spikes, minute, in Malaysia exclusively ♀. Perianth  $\pm 1\frac{1}{4}$  mm long, externally at the base with a dense whorl of long white hairs, otherwise subglabrous, nerveless. Stigmas 2, ascending, subulate . . . . . 16. *Iresine*
10. Otherwise.
11. Anthers 2-celled (4-locellate).
12. Filaments 5, alternating with pseudo-staminodes.
13. Pseudo-staminodes short, with a broad, truncate or subdentate apex. Flowers glabrous, united in a (finally) long spike, after anthesis widely patent or reflexed. Bracteoles, or one or more tepals, after anthesis with a very acute, often pungent tip. Stigma capitate, entire.
14. Aquatic. Bracteoles broadly ovate-orbicular, membranous, not spinous. Tepals very unequal, outermost one spine-tipped . . . . . 10. *Centrostachys*
14. Terrestrial. Bracteoles consisting of a rather long spine bearing on either side of its long concave base a much shorter, membranous nerveless wing. Tepals not very unequal, after anthesis spinous or not . . . . . 11. *Achyranthes*
13. Pseudo-staminodes subulate. Flowers either white-pilose or thinly beset with short hairs and then strongly nerved, not pungent . . . . . 8. *Aerva*
12. No pseudo-staminodes. Style at best  $\frac{1}{2}$  mm long. Leaves glabrous.
15. Stamens 1-2. Spikes usually clustered,  $\frac{1}{2}$ - $1\frac{1}{2}$  cm long. Tepals nerveless, hairy outside . . . . . 9. *Nothosaerva*
15. Stamens 5. Spikes solitary or sometimes paired,  $1-2\frac{1}{2}$  cm long. Tepals strongly nerved, glabrous . . . . . 13. *Psilotrichum*
11. Anthers 1-celled (2-locellate), or absent and replaced by spurious ovaries.
16. Stigma 1, capitate, entire . . . . . 14. *Alternanthera*
16. Stigmas 2, erect or spreading, sometimes minute . . . . . 15. *Gomphrena*
9. Flowers racemed or spicate, lower ones accompanied by fascicled hooks (difformed flowers). Hooks hairy at the base, upwards glabrous. Perianth pilose outside. Style 1, stigma capitate. Fruit falling off together with the hooks, by means of these easily adhering to passers-by.
17. Filaments alternating with short, broad pseudo-staminodes. Old flowers deflexed, accompanied by sessile or subsessile fascicles of obliquely erect,  $1\frac{3}{4}$ - $2\frac{1}{2}$  mm long hooks . . . . . 6. *Cyathula*
17. No pseudo-staminodes. Old flowers widely patent with distinctly stalked fascicles of squarrose, 3-4 mm long hooks . . . . . 7. *Pupalia*

# 1. DEERINGIA

R.Br. Prod. (1810) 413.

Erect herbs or scandent or clambering shrubs, unarmed. *Leaves* alternate, petioled, ovate to lanceolate, acute, entire. *Flowers* in axillary and terminal, simple or branched, frequently panicle racemes or spikes, solitary in the axil of a bract, subtended by 2 bracteoles. *Tepals* 5, rarely 4, oval-oblong, 1-nerved with scarious margins, glabrous. Stamens 5, rarely 4, filaments at the base united in a cup; free parts distant, filiform-subulate; no pseudo-staminodes; anthers 2-celled (4-locellate). Ovary sessile or shortly stalked; ovules few to many; funicles long; stigmas 2-3, rarely 4, linear or  $\pm$  clavate. *Fruit* baccate, thin-walled, indehiscent, globose, broadly ellipsoid or obovoid, falling out of persistent perianth when ripe; seeds 0 to many, on long pale funicles, circular or reniform, shining black or brownish black, very finely verruculose or almost smooth.

Distr. About 7 spp. in the palaetropics from Madagascar to Australia.

Ecol. Unlike most Malaysian *Amaranthaceae* the species of this genus are not anthropochorous; as a rule they inhabit forests.

Uses. Only one species used by the Malaysians, mainly medicinally.

Notes. This is the only Malaysian *Amaranthaceous* genus of which the fruits (red or white berries) fall off unopened, leaving behind bracts, bracteoles and perianth.

#### KEY TO THE SPECIES

1. Single flowers sessile or subsessile. Single spikes consisting of 50 or fewer flowers. Flowers ♂ or (♂) (♀). Tepals appressed against the ripe living berry. Seeds distinctly verruculose.
2. Flowers ♂, in simple or very sparingly branched spikes or sometimes solitary. Perianth  $2\frac{1}{4}$ – $2\frac{1}{2}$  mm long. Free parts of the filaments about as long as the staminal cup or but slightly longer.
3. Spikes rather less than 1 cm long. Flowers very few, occasionally 1. Ripe berry red. Seeds 1–4. Climber . . . . . 3. *D. tetragyna*
3. Spikes 3–12 cm long. Flowers 4–50. Ripe berry white. Seeds 10–64. Erect herb or undershrub, 1–2 m high . . . . . 2. *D. polysperma*
2. Flowers (♂) (♀) (male ones spuriously bisexual but ovary empty), in paniced spikes. Branches of the panicle widely patent. Perianth  $1\frac{1}{4}$ –2 mm long. Free parts of the filaments in ♂ much longer than the staminal cup. Ripe berry bright red. Seeds 1–2. Very tall climber . . . . . 4. *D. arborescens*
1. Single flowers on  $\frac{2}{3}$ –2 mm long pedicels, ♀. Single racemes often consisting of more than 50 flowers. Free parts of the filaments several times longer than the staminal cup. Tepals under the ripe living berry patent or reflexed. Ripe berry bright red. Seeds 0–9, almost smooth . . . . . 1. *D. amaranthoides*

1. *Deeringia amaranthoides* (LAMK) MERR. Interpr. Herb. Amb. (1917) 211; Spec. Blanc. (1918) 136; En. Philip. Fl. Pl. 2 (1923) 126.—*Achyranthes amaranthoides* LAMK, Enc. 1 (1785) 548.—*Celosia baccata* RETZ, Obs. 5 (1789) 32; BLANCO, Fl. Filip. (1837) 193.—*Deeringia celosioides* R.Br. (non HASSK. 1848) Prod. (1810) 413; DECNE in Nouv. Ann. Mus. 3 (1834) 371; SPAN. in Linnaea 15 (1841) 345; BLANCO, Fl. Filip. ed. 2 (1845) 135; ed. 3, 1 (1877) 244, t. 236; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1025; BTH. Fl. Austr. 5 (1870) 209; F.V.M. Descr. Not. pt 3 (1876) 41; HOOK. f. Fl. Br. Ind. 4 (1885) 714; BAIL. Queensl. Fl. pt 4 (1901) 1218; RIDL. Fl. Mal. Pen. 3 (1924) 4; HEYNE, Nutt. Pl. (1927) 604; OCHSE & BAKH. v. D. Br. Veget. (1931) 30, fig. 19; GAGN. in Fl. Gén. I.C. 4 (1936) 1055.—*Deeringia indica* RETZ ex BL. Bijdr. (1825) 542; HASSK. Pl. Jav. Rar. (1848) 436.—*Lestibudesia philippica* WEINM. Syll. Ratisb. 1 (1828) 118.—*Celosia philippica* STEUD. Nom. ed. 2 (1841) 316, MIQ. in DC. Prod. 13, 2 (1849) 241, MERR. En. Philip. Fl. Pl. 2 (1923) 127.—*Deeringia baccata* Moq. in DC. Prod. 13, 2 (1849) 236; FORBES, Wand. (1885) 515 and 502 (here doubtfully but wrongly as *Gouania leptostachya* DC.); KOORD. Exk. Fl. 2 (1912) 194; MERR. Fl. Man. (1912) 190; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1921) 628.—*Iresine amaranthoides* Moq. in DC. Prod. 13, 2 (1849) 348.—*Cladostachys baccata* O.K. Rev. 2 (1891) 541.—Fig. 1.

Scandent or clambering shrub, often with long, pendulous branches, 2–6 m (to up to 15 m ?) high; stem in the higher part obtusangular and finely appressed pubescent, at an advanced age terete and glabrous. Leaves ovate or ovate oblong-sublancoate, base acute, obtuse, rounded or subtruncate, often unequal, frequently shortly contracted into the petiole, tapering towards the apex or acuminate, acute, crowned by a longish, often caducous mucro, at first on both surfaces very thinly patently pilose, glabrescent, 4–15 by 2–8 cm (floral leaves often much smaller); midrib in the living plant distinctly prominent beneath; petiole 1–6 cm. Flowers racemed; racemes axillary and terminal,

very often divaricately branched, 5–35 cm (0–8 cm peduncle included), rather dense or in lower part lax, often more than 50-flowered; highest racemes usually collected in a terminal panicle of 15–75 cm



Fig. 1. *Deeringia amaranthoides* (LAMK) MERR. from Java,  $\times \frac{1}{5}$ .

long; rachises of inflorescence finely and not very densely appressed pubescent; bracts narrowly triangular, very acute,  $\pm 1\frac{1}{2}$  mm; bracteoles ovate, acute,  $\pm 1$  mm. Flowers solitary or clustered, malodorous. Pedicels  $\frac{2}{3}$ –2 mm. Tepals during anthesis widely patent or reflexed, under the fruit reflexed as are the stamens, obtuse or rounded, concave, pale green or somewhat yellowish, white-margined, often, especially under the fruit, tinged with red,  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm long. Staminal cup  $\frac{1}{4}$ – $\frac{1}{3}$  mm; free parts of the filaments several times longer



than the cup, for the rest variable as to length,  $1\frac{1}{2}$ – $2\frac{3}{4}$  mm. Stigmas 3, greenish white,  $1$ – $1\frac{1}{2}$  mm, recurved on the fruit. *Berry* globose-obovoid, bright red, 4–7 mm diam. Seeds 0–9, usually no more than 5, circular with emarginate base,  $1$ – $1\frac{1}{3}$  mm diam., almost smooth.

Distr. From India to China, southward to Australia, in *Malaysia*: throughout, not yet reported from the Moluccas & Borneo.

Ecol. In Java, especially in the drier eastern half, 1–1500 m, in teak- and open mixed forest, forest borders, secondary forests, tall brush-wood, hedges, often, though by no means exclusively, on calcareous soil. Sometimes cultivated for its medicinal properties.

Uses. The natives press the root in diluted vinegar and add a piece of onion (Dutch: *ajuin*; BURKILL (Dict. 775) mistranslated *alum* = *aluin*). The juice so obtained is sniffed up; it looses the mucus and cures the head-ache caused by obstruction of the nasal cavities. The leaves are applied to sores; young cooked sprouts are eaten with rice.

Vern. *Bayam besar*, *bayam pohon*, *pantjar luhur*, *tangtang angin*.

Notes. The specimens found in native hedges may have been planted. *D. amaranthoides*, *D. baccata*, and *D. celosioides* are considered specifically distinct by SUESSENGUTH (FEDDE, Rep. 44 (1938) 39). I cannot agree with this view; the differences mentioned by S. are hardly of any importance and moreover are very inconstant in Malaysian materials.

**2. *Deeringia polysperma* (ROXB.) MOQ. in DC. Prod. 13, 2 (1849) 236; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1026; KOORD. Exk. Fl. 2 (1912) 194; MERR. En. Philip. Fl. Pl. 2 (1923) 126; GAGN. in Fl. Gén. I.C. 4 (1936) 1056.—*Celosia polyperma* ROXB. Fl. Ind. 2 (1824) 511.—*Lestibudesia latifolia* BL. Bijdr. (1825) 541.—*Celosia latifolia* STEUD. Nom. ed. 2 (1840) 315; MOQ. in DC. Prod. 13, 2 (1849) 244; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1027.—*Deeringia indica* ZOLL. ex Moq. in DC. Prod. 13, 2 (1849) 236; ZOLL. Syst. Verz. (1854) 110; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1026; KOORD. Minah. (1898) 565; RIDL. Fl. Mal. Pen. 3 (1924) 5.—*Deeringia celosioides* (non R.Br. 1810) HASSK. Pl. Jav. Rar. (1848) 436.—*Deeringia indica* var. *pubescens* SCHINZ in Bull. Herb. Boiss. II, 3 (1903) 3.—*Deeringia polysperma* var. *pubescens* MERR. En. Philip. Fl. Pl. 2 (1923) 126.—*Deeringia salicifolia* SCHINZ in E. & P. Nat. Pfl. Fam. ed. 2, 16c (1934) 27, *nomen*.**

Erect herb or undershrub, 1–2 m. Young stems, petioles, leaves, rachises of the spikes, bracts and bracteoles frequently clothed with shortish, thickish brown hairs, glabrescent; stem in the higher part obtusangular. *Leaves* ovate-oblong-lanceolate from a cuneate or shortly contracted base, narrowed upwards or slightly acuminate, acute, herbaceous or slightly fleshy, 3–22 by  $1\frac{1}{2}$ –12 cm; midrib in the living plant slightly prominent beneath; petiole  $\frac{1}{2}$ –5 cm. *Flowers* spicate; spikes axillary, single or sometimes paired, erect or more or less patent, simple or sometimes sparingly branched, 3–12 cm long, rather dense or, at an

advanced age, rather lax, 4–50-flowered. Flowers quite sessile; bracts broadly ovate, obtuse or rather acute,  $\pm 1\frac{1}{2}$  mm long; bracteoles ovate,  $1$ – $1\frac{1}{4}$  mm. *Perianth*  $2\frac{1}{4}$ – $2\frac{1}{2}$  mm long. *Petals* during anthesis erect or obliquely erect, afterwards appressed to the fruit, very obtuse, green, white-bordered. Staminal cup  $\frac{3}{4}$ –1 mm high; free parts of the filaments about as long as the cup or slightly longer. Stigmas 2–3, recurved or on the fruit obliquely erect or patent,  $\frac{1}{2}$ – $\frac{2}{3}$  mm long. *Berry* globose or broadly ellipsoid, white,  $\pm 3$  mm diam. Seeds 10–64, usually more than 20, reniform,  $\pm \frac{3}{4}$  mm diam, very finely verruculose.

Distr. *Malaysia*: Mal. Peninsula, Sumatra, Java, Philippines, Celebes, Kabaena, Moluccas, and New Guinea.

Ecol. In Java, 5–800 m alt. (in the Philippines ascending to 1800 m, according to MERRILL), in thickets and shaded localities, in forests and on forest borders, much rarer than *D. amaranthoides*.

Notes. In a fruiting state conspicuous by its white berries.

**3. *Deeringia tetragyna* ROXB. Fl. Ind. ed. CAREY (1832) 683; WIGHT, Ic. 2 (1843) 729; MIQ., Fl. Ind. Bat. I, 1 (1858) 1026. Climbing shrub, entirely glabrous; young shoots pendulous. *Leaves* ovate from a broad, rounded base, shortly contracted into petiole, shortly acuminate, acute, slightly undulate, 3–7 cm by 2–4 cm; petiole  $\frac{3}{4}$ – $1\frac{1}{2}$  cm. *Flowers* axillary, spicate or sometimes solitary; spikes erect, shortly stalked, rather less than 1 cm long, few-flowered, dense; bracts ovate-oblong, obtuse,  $\pm 1\frac{1}{2}$  mm; bracteoles much shorter than perianth, oblong, obtuse. *Petals* 4–5, oval-oblong, obtuse, very concave,  $2\frac{1}{4}$ – $2\frac{1}{2}$  mm long. Stamens about equalling perianth; staminal cup rather large; free parts of filaments linear from triangular base, about as long as cup or slightly longer. Ovary subglobose, with 3–4 longitudinal furrows, few-ovuled; styles 3–4, recurved, linear-subclavate. *Berry* (not seen) subglobose,  $\pm$  lobed, red, succulent. Seeds 1–4, mostly 1.**

Distr. *Malaysia*: Moluccas (according to ROXBURGH).

Notes. This imperfectly known species of which I could examine the type specimen I find to represent a distinct species which is tolerably well figured by WIGHT. Its native country is said to be the Moluccas on the authority of ROXBURGH l.c. who states that it was accidentally introduced from there into the Botanic Gardens, Calcutta. It is strange that it has never been re-collected.

**4. *Deeringia arborescens* (R.Br.) DRUCE, Rep. Bot. Exch. Club Br. Isl. 1916, 619 (1917); DOMIN, Bibl. Bot. 89 (1921) 74; Beitr. Pflanzengeogr. Austr. 1, 2 (1921) 628.—*Lestibudesia arborescens* R.Br. Prod. (1810) 414.—*Celosia arborescens* SPRENG. Syst. 1 (1825) 815; MOQ. in DC. Prod. 13, 2 (1849) 243.—*Lagrezia altissima* Moq. in DC. Prod. 13, 2 (1849) 253.—*Deeringia altissima* F.v.M. Fragm. Phyt. Austr. 2 (1861) 92, l.c. 6 (1864) 251; BTH. Fl. Austr. 5 (1870) 210; HEMSL. Rep. Bot. Chall. 1, 3 (1884) 182; F.v.M. Descr. Not.**

Pap. Pl. 7 (1886) 28; BAILEY, Queensl. Fl. pt 4 (1901) 1219.—*Cladostachys altissima* O.K. Rev. 2 (1891) 541.

Woody climber, ascending to top of tallest trees (ex БН.), glabrous or on young vegetative parts clothed with brown,  $\pm$  crisped hairs. *Leaves* oblong or lanceolate from a cuneate or contracted base, obtuse or rather acute, firmly herbaceous, 5–20 by  $1\frac{1}{2}$ –10 cm; petiole  $1\frac{1}{2}$ – $3\frac{1}{2}$  cm. *Flowers* ( $\delta$ ) ( $\varphi$ ) (male ones pseudo-hermaphrodite), paniced; single panicles 4–15 cm long, axillary and terminal; highest often collected in a terminal, rather large panicle; branches of single panicles widely patent, spiciform, dense or rather lax, 1–3 cm long. *Flowers* sessile or subsessile, glabrous; bracts and bracteoles thinly membranous, nerveless.— $\delta$ : Bracts ovate-orbicular, rounded,  $\pm$  1 mm long; bracteoles slightly smaller than the bract, much shorter than the perianth,  $\pm$   $\frac{3}{4}$  mm diam; perianth white. *Tepals* oblong or oblong-obovate, rounded at apex, very convex, nerveless,  $1\frac{1}{2}$ –2 mm long. Adult sta-

mens slightly exceeding the perianth; filaments thin, finally much longer than the short staminal cup; anthers oblong, yellow. Ovary shortly stalked, conical, glabrous, empty; style very short; stigmas 3, linear-clavate, short, thick, recurved.— $\varphi$ : Bracts and bracteoles much shorter than perianth,  $\pm$  1 mm long; bracts ovate-triangular, bracteoles oval. Perianth greenish,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long, at last appressed against ripe fruit. Staminodes 5, varying from slightly shorter to slightly longer than perianth; filaments at base connate in a comparatively large and wide cup; their free parts slightly longer than cup; their anthers deformed, small, empty. Ovary subglobose, 6–15-ovuled; style short; stigmas 3, recurved, shortly linear, thick. *Berry* globose, red, with the top exerted from the perianth, 3–4 mm diam. Seeds 1–2, reniform, black, densely verruculose,  $\pm$  1 mm diam.

Distr. NE. Australia, in *Malaysia*: collected in Buton Isl. (SE. Celebes), the Tanimbar Isl. (S. Moluccas), and SE. New Guinea (Saibai Island)

## 2. CELOSIA

LINNÉ, Sp.Pl. 1 (1753) 205.

Erect, entirely glabrous annuals. Stem angular-ribbed. *Leaves* alternate, petioled, ovate to linear, entire or subentire, often with small semilunar leaves in the axils. *Flowers*  $\varphi$ , in simple or branched, dense or interrupted, sometimes deformed, terminal or axillary spikes, solitary in axil of bract, subtended by 2 bracteoles. *Tepals* 5, free, during anthesis erecto-patent or spreading, before and after anthesis erect, ovate-oblong, acute, scarious, longitudinally nerved. Stamens 5; filaments at the base connate in a cup; free parts linear from a triangular base, often alternating with minute, triangular pseudo-staminodes; anthers oblong-linear, 2-celled (4-locellate). Ovary sessile with broad base; ovules  $\infty$ , on short funicles; style 1, filiform, persistent; stigma capitate, faintly 2–3-lobed. *Utricle* thin-walled, circumsciss in or about the middle. Seeds 1– $\infty$ , lenticular, shining black.

Distr. About 60 spp. mainly in the subtropics and temperate regions of Africa and America, in *Malaysia*: no indigenous species.

In *Malaysia* one wild species, and several more or less deviating forms which are cultivated for ornamental purposes.

1. *Celosia argentea* LINNÉ, Sp.Pl. (1753) 205; BL. Bijdr. (1825) 543; DECNE in Nouv. Ann. 3 (1834) 372; BLANCO, Fl. Filip. (1837) 192; ed. 2 (1845) 135; ed. 3, 1 (1877) 243; SPAN. in Linnaea 15 (1841) 345; MOQ. in DC. Prod. 13, 2 (1849) 242; HASSK. in Pl. Jungh. (1852) 128; MIQ., Fl. Ind. Bat. I, 1 (1858) 1028; HOOK. f. Fl. Br. Ind. 4 (1885) 714; BAILEY, Queensl. Fl. pt 4 (1901) 1218; LAUT. & SCHUM. Fl. D. Schutzg. (1901) 303; PULLE in Nov. Guin. 8 (1910) 351; KOORD. Exk. Fl. 2 (1912) 194; MERR. Fl. Man. (1912) 190; ASCH. & GR. Syn. 5, 1 (1913) 222; MERR. Interpr. Herb. Amb. (1917) 212; EN. BORN. Pl. (1921) 245; EN. PHILIP. Fl.Pl. 2 (1923) 127; RIDL. Fl. Mal. Pen. 3 (1924) 5; HEYNE, Nutt. Pl. (1927) 604; BACKER, Onkr. Suiker. (1930) 216, Atl. t. 226; OCHSE & BAKH. v. D. B. Veget. (1931) 27, fig. 17, 28, fig. 18; GAGN. in Fl. Gén. I.C. 4 (1936) 1056.—*Celosia cristata* LINNÉ Sp.Pl. (1753) 205, BLANCO, Fl. Filip. (1837) 191, &c.; KOORD.

Exk. Fl. 2 (1912) 195; HEYNE, Nutt. Pl. (1927) 605.—*Celosia coccinea* LINNÉ, Sp.Pl. ed. 2 (1762) 297; BLANCO Fl. Filip. ed. 2 (1845) 134; op cit. ed. 3, 1 (1877) 241, t. 64, &c.—*Celosia pyramidalis* BURM. f. Fl. Ind. (1768) 65, t. 25, fig. 1.—*Celosia huttonii* MAST. in Gard. Chron. 1872, 215; ASCH. & GRAEBN. Syn. 5, 1 (1913) 222.

*Forma spontanea*: Annual, 0.4– $1\frac{1}{2}$  m; stem erect, green or red, strongly ribbed, often much branched. *Leaves* on petioles of  $\frac{1}{4}$ – $\frac{3}{4}$  cm or highest almost sessile, oblong-lanceolate or lanceolate-linear, rarely ovate-oblong, acute at both ends, herbaceous, often tinged with red, 4–18 by  $\frac{3}{4}$ – $6\frac{1}{2}$  cm; highest often very small; leaf axils often provided with  $\pm$  falcate small leaves. *Spikes* solitary or sometimes paired, erect, stalked or partly subsessile, often much lengthening during anthesis, at length cylindrical with a conical apex, very dense, throughout their length (when pure-

bred) with ♂ flowers, usually simple, sometimes bifid or trifid at apex, 2–22 by 1–1<sup>3</sup>/<sub>4</sub> cm; their stalk ribbed-furrowed, often lengthening during anthesis, finally 1<sup>1</sup>/<sub>2</sub>–21 cm. *Flowers* solitary, sessile, obliquely patent; bracts and bracteoles persistent after fall of the perianth, ovate-oblong, pellucid, 1-nerved, mucronate, 3–7 mm long. Perianth 6–10 mm, at first shining white with a pink tip or almost entirely pink, withering white. Adult staminal cup 1<sup>1</sup>/<sub>2</sub>–2 mm high; free part of filaments 2<sup>1</sup>/<sub>2</sub>–3 mm; pseudo-staminodes minute, triangular. Style violet, 3<sup>1</sup>/<sub>4</sub>–5 mm. *Utricle* included by the perianth, obovoid with rounded apex, ± 3<sup>1</sup>/<sub>2</sub> mm long. Seeds 1–9, 1<sup>1</sup>/<sub>4</sub>–1<sup>1</sup>/<sub>2</sub> mm diam.

*Distr.* Ubiquist, in *Malaysia*: wild but not native, introduced here perhaps very long ago (from trop. Africa?), thoroughly established in the settled areas throughout the Archipelago.

*Ecol.* In Java, 1–700 m alt., a rather common weed of open dry localities, field, gardens, waste places, locally often numerous.

*Uses.* Seeds used by the Chinese for poultices and for adorning cakes. The leaves furnish an inferior vegetable.

*Vern.* *Borotjo*, S.

*Notes.* *Forms cultivated* for ornamental purposes are found throughout Malaysia; not unfrequently such forms are met with as garden escapes. These latter may breed true but often also they display to a great and variable degree a regression to the wild form, possibly due to intercrossing with it. One branch of a plant may bear the marks of cultivation (in the shape of sterile flowers) whilst another is quite alike the wild form.

In cultivated forms the higher flowers of the inflorescence are sterile, the rest fertile; the fertile flowers being usually somewhat smaller than those

of the wild form; the entire inflorescence is usually red, violet, yellow or orange. It may have the shape of an almost sessile cock's comb with a thick sinuous crest; this form usually goes under the name of *C. cristata* L. This is a very common ornamental plant in Malaysia where it reaches a height of 0.4–1<sup>1</sup>/<sub>2</sub> m; the inflorescence is usually bright red; the ovate leaves often bear a large bright red blotch. In another series of cultivated forms (*forma plumosa* (Voss.) BACK.) the inflorescence is loosely branched; the branches are cylindric and have a much constricted tail-like sterile upper part. The two forms may be found on a single plant; the terminal inflorescence being more or less cock's-comb-like, the lower ones cylindrical, tail-ended.

#### Excluded

*Celosia nana* BLANCO, Fl. Filip. (1837) 192 = *Alternanthera celosioides* MOQ. in DC. Prod. 13, 2 (1849) 360 are according to MERRILL (En. Philip. Fl.Pl. 3 (1923) 135) = *Ammannia baccifera* L. (*Lythr.*)

#### Doubtful

*Celosia cernua* JUSS.; F.-VILL. Noviss. Append. (1880) 168.

*Celosia phytolaccaefolia* JUSS.; F.-VILL. Noviss. Append. l.c.

*Celosia bicolor* BLANCO, Fl. Filip. (1837) 191; MERR. Spec. Blanc. (1918) 383.—*Celosia glauca* (non ROTTL.) BLANCO, op. cit. ed. 2 (1845) 135, ed. 3, 1 (1877) 242. The form BLANCO described was according to MERRILL (Enum. Philip. Fl.Pl. 2 (1923) 127) certainly no amaranthaceous plant, and may possibly have been a species of *Ammannia* (*Lythrac.*)

### 3. ALLMANIA

R.BR. *ex* WIGHT, in HOOK. J. Bot. (1834) 226, t. 128.

Erect or ascending annual. *Leaves* alternate, varying from linear to obovate, entire. *Flowers* ♀, in terminal or (by development of an axillary branch) leaf-opposed heads; heads stalked or subsessile, composed of crowded, 3–7-flowered cymes; flowers solitary in the axil of a bract, subtended by 2 bracteoles which partly act as bracts to branches of a cyme. Tepals free or nearly so, erect or erecto-patent, subequal, ovate-lanceolate, pellucid with green or purple midrib. Stamens 5; filaments at base connate in a short cup; anthers 2-celled (4-locellate); no pseudo-staminodes. Ovary ovate, compressed, narrowed into style; ovule 1, erect on short, broad funicle; style filiform, stigma capitate, faintly 2-lobed. *Utricle* enclosed by the perianth, ovoid, compressed, thin-walled, circumsciss below the middle. Seed erect, lenticular, at base with a cupular, 2-lobed, thin aril.

*Distr.* Monotypic, trop. Asia and *Malaysia*.

*Notes.* There is only one variable species, described under several names. All forms pass gradually into each other.

1. *Allmania nodiflora* (L.) R.Br. in WALL. Cat. (1832) 6890, *nomen*; HOOK. f. Fl. Br. Ind. 4 (1885) 716; KOORD. Exk. Fl. 2 (1912) 195; RIDL. Fl. Mal. Pen. 3 (1924) 5; BACKER, Onkr. Suiker. (1930) 217,

Atlas t. 227; GAGN. in Fl. Gén. I.C. 4 (1936) 1059. —*Celosia nodiflora* LINNÉ, Sp.Pl. (1753) 205; BURM. f. Fl. Ind. (1768) 66.—*Allmania albida* R. Br. in WALL. Cat. 6981 (1832), *nomen*; HOOK. f.

Fl. Br. Ind. 4 (1885) 717; MERR. En. Philip. Fl. Pl. 2 (1923) 127; GAGN. in Fl. Gén. I.C. 4 (1936) 1059. —*Allmania esculenta* R. BR. in WALL. l.c. 6892. —*Chamissoa brownei* STEUD. Nom. ed. 2 (1841) 344. —*Chamissoa javanica* HASSK. Fl. Jav. Rar. (1848) 434; MOQ. in DC. Prod. 13, 2 (1849) 249. —*Chamissoa albida* MOQ. in DC. Prod. 13, 2 (1849) 248. —*Chamissoa esculenta* MOQ. l.c. 249. —*Chamissoa nodiflora* MART. ex MOQ. l.c.; HASSK. in Pl. Jungh. (1852) 129; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1029; Suppl. (1860) 149. —*Chamissoa pyramidalis* MOQ.<sup>1</sup> l.c. 248. —*Allmania pyramidalis* KOORD. Exk. Fl. 2 (1912) 195.

Erect or ascending annual 0.1–0.8 m long; taproot long; stem branched from the base or nearly so, solid with thickened nodes, glabrous or obscurely thinly pubescent. *Leaves* linear, spatulate, oblong or obovate, narrowed into petiole, acute, obtuse, rounded or abruptly shortly acuminate, mucronate, glabrous or on undersurface thinly pubescent, rather fleshy,  $1\frac{1}{2}$ – $6\frac{1}{2}$  by  $\frac{1}{3}$ – $2\frac{1}{2}$  cm; petiole 2–10 mm. Heads terminal or leaf-opposed, at first subglobose, afterwards somewhat lengthened,  $\frac{3}{4}$ –2 cm long; their stalk 2–35 mm, rather robust, scantily hairy or glabrous; single cymes sessile, 3–7-flowered; bracts and bracteoles ovate-lanceolate, long acuminate, keeled, 3–5 mm long; midrib green or purple; margins shining

white; keel scaberulous outside. *Tepals* before and after anthesis erect, during anthesis obliquely spreading, with strong, green or purple midrib and pellucid white, shining margins, glabrous or scaberulous on back, 4–5 mm long. Stamens shorter than perianth. Ovary and style glabrous; style during anthesis  $\pm 2$  mm, on fruit (conical base included)  $\pm 3$  mm; stigma about as high as anthers. *Utricle* glabrous,  $\pm 3\frac{1}{2}$  mm; seed shining black,  $\pm 2\frac{1}{2}$  mm diam.; aril enclosing base of seed, pale pink or pale brown.

Distr. Tropical Asia; in *Malaysia*: Singapore, Sumatra, Java, Madura, Sumba, Wetar & the Philippines.

Ecol. In Java from the plains up to  $\pm 100$  m alt. (very rarely higher), locally often a rather common weed on light especially sandy soils, sandy shores, fields, roadsides and dunes.

Uses. Long ago reported to be eaten at Singapore.

Notes. Often split into 2 species: *A. nodiflora* with sessile heads and *A. pyramidalis* with peduncled ones. This difference exists only on paper, not in nature where the two forms pass into each other. I never saw a form with *quite sessile* heads. SCHINZ (in E. & P. Nat. Pfl. Fam. ed. 2, 16c, p. 33) figures *A. nodiflora* with clearly peduncled heads but he described them as sessile.

#### 4. AMARANTHUS

LINNÉ, Sp. Pl. 1 (1753) 989.

Annuals, erect or wholly or partly decumbent, unarmed or spinous. *Leaves* alternate, entire. *Flowers* ( $\sigma$   $\varphi$ ) in sessile, small, dense clusters, clusters axillary or collected in axillary and terminal, solitary or paniced spikes. Flowers solitary in the axil of a bract, sustained by 2 bracteoles; bracts and bracteoles small, scarious. *Tepals* 3 or 5, rarely 4, erect or obliquely patent, free, subequal, membranous, green, purple, or pellucid with a green or purple median band, after anthesis sometimes indurate at base. Stamens as many as tepals; filaments free, filiform, no pseudostaminodes; anthers 2-celled (4-locellate). Ovary ovate or oblong, ovule 1, sessile, erect; style short or none; stigmas 2–4, often 3, erect or spreading-recurved, linear. *Utricle* laterally compressed, membranous, circumsciss when ripe or bursting irregularly or falling off unopened together with the perianth; seed erect, lenticular, shining black or brown.

Distr. About 40  *spp.* all over the world, specially developed outside the tropics, several elsewhere introduced. Most of the Malaysian species are ubiquitous; of some the native country is unknown. Of the 7 wild Malaysian species one is frequently also cultivated; the two others are almost exclusively cultivated but occasionally met with as strays from gardens.

Ecol. Weeds of waste places, roadsides, fields and gardens, locally sometimes gregarious.

Uses. Some species serve as vegetables; some are used medicinally or for ornamental purposes.

Vern. In the Malay language all species are called *bayam* (with various additions).

Notes. Probably several of the Malaysian species have been introduced.

#### KEY TO THE SPECIES

1. Utricles,<sup>2</sup> also when adult and quite ripe, indehiscent or at last bursting irregularly, falling off together with the perianth. *Tepals* very shortly mucronate. Stigmas very short ( $\frac{1}{4}$ – $\frac{2}{3}$  mm), erect or suberect. Bracts and bracteoles shorter than the perianth. Unarmed.

(1) Not *Celosia pyramidalis* BURM. f. which is *Celosia argentea* L.

(2) See footnote next page.

2. Tepals in all flowers 3, exceptionally 4.
3. Ripe utricle very strongly corrugated, seed-containing part entirely included by the perianth, from which only the seedless conical beak emerges . . . . . **1. A. gracilis**
3. Ripe utricle smooth or faintly rugulose, top of the seed-containing part slightly emerging from the perianth . . . . . **2. A. lividus**
2. Tepals 5. Ripe utricles in a dried state faintly longitudinally ribbed and  $\pm$  rugulose . . . . . **3. A. interruptus**
1. Adult *quite ripe* utricles<sup>1</sup> circumscrib a little below the middle. Perianth and cup-shaped base of the utricle persisting till after the fall of the lid and the seed. Stigmas  $3/4$ – $2\frac{1}{2}$  mm, often recurved when long.
4. Tepals in all or most flowers 5, less often 4, rarely (only in a few flowers) 3, *shortly mucronate*.
5. Flower clusters *for a great part* solitary in the higher leaf axils, for the rest collected in spikes or panicles which terminate the main stem and its branches. Bracts not longer than the perianth.
6. Axillary flower-clusters exclusively  $\varnothing$ ; those of the spikes and panicles for the greater part or almost entirely  $\sigma$ . Midrib of the tepals not much broadened upwards.
7. Style  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long.  $\varnothing$  clusters usually armed with 2 very sharp spines, rarely with 1 spine only or unarmed. Midrib of the tepals green or purple . . . . . **5. A. spinosus**
7. Style  $1/4$ – $1/2$  mm long. Flower-clusters unarmed. Midrib of the tepals green. Small plant . . . . . **6. A. leptostachyus**
6. Terminal spike of the main stem almost entirely  $\varnothing$ , other spikes entirely  $\sigma$ , or at their base  $\sigma$ , higher up  $\varnothing$ . Midrib of the tepals green, in the lower half very thin, in the upper half (up to quite near the apex) much thickened. Unarmed . . . . . **7. A. dubius**
5. Flower clusters *all* collected in terminal and axillary panicles of spikes. Bracts often longer than the perianth.
8. Tepals of  $\varnothing$  flowers not or hardly overlapping,  $1/3$ – $1/2$  mm wide. Panicles erect, or nodding only in their upper half. Cultivated and occasionally met with as an escape from gardens . . . . . **8. A. hybridus**
8. Tepals of  $\varnothing$  flowers distinctly overlapping for the greater part of their length,  $2/3$ – $3/4$  mm wide. Panicles (in Malaysian specimens) drooping almost from the very base. Possibly exclusively cultivated. . . . . **9. A. caudatus**
4. Tepals in all flowers 3, *provided with a long apical awn* . . . . . **4. A. tricolor**

**1. *Amaranthus gracilis* DESF.** Tabl. Ec. Bot. (1804) 43; THELLUNG in ASCH. & GR. Syn. 5, 1 (1914) 335; DOMIN. Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 634; HEYNE, Nutt. Pl. (1927) 605; BACKER, Onkr. Suiker. (1930) 222, Atl. t. 232; OCHSE & BAKH. v. D. BR. Veget. (1931) 18.—*Amaranthus viridis* LINNÉ, Sp.Pl. ed. 2, 2 (1763) 1405, *ex parte*; BTH. Fl. Austr. 5 (1870) 215; HOOK. f. Fl. Br. Ind. 4 (1885) 720; BAILEY, Queensl. Fl. pt. 4 (1901) 122; PULLE, Nova Guinea 8 (1910) 351; KOORD. Exk. Fl. 2 (1912) 197; MERR. Interpr. Herb. Amb. (1917) 212; EN. BORN. (1921) 246; EN. PHILIP. Fl.Pl. 2 (1923) 128; GAGN. in Fl. Gén. I.C. 4 (1936) 1064.—*Chenopodium caudatum* JACQ. Coll. 2 (1788) 235 (*non Amaranthus caudatus* L.).—*Amaranthus polystachyus* WILDL. Sp.Pl. 4 (1805) 385; BLUME, Bijdr. (1825) 538; KOORD. Exk. Fl. 2 (1912) 197.—*Euxolus caudatus* MOQ. in DC. Prod. 13, 2 (1849) 274; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1036.—*Euxolus polystachyus* MIQ. Fl. Ind. Bat. 1, 1 (1858) 1036.

Annual, erect, ascending or rarely prostrate, 10–75 cm long, often much branched, unarmed; stem terete-obtusangular, glabrous or thinly pubescent. *Leaves* (larger ones at least) rather long-petioled, ovate-rhomboid-oblong from obtuse or cuneate, often decurrent base, acute, obtuse, rounded or retuse, glabrous or on stronger nerves spar-

ingly pubescent, green; larger ones 3–9 by 2– $6\frac{1}{2}$  cm. *Flowers* green; lower clusters axillary; upper ones in terminal, rather dense, continuous or interrupted ( $\sigma$ ) spikes or panicles; bracts and bracteoles ovate, minutely mucronate, shorter than adult perianth; tepals 3 (exceptionally 4), very shortly mucronate with transparent white margins and green median band, glabrous, very convex, in  $\sigma$  oblong-linear,  $\pm 1\frac{1}{2}$  mm long, in  $\varnothing$  narrowly oblong-spathulate, during anthesis  $2/3$ –1 mm, when fruiting  $1\frac{1}{4}$ – $1\frac{3}{4}$  mm long;  $\sigma$  flowers often with rudimentary filiform ovary; ovary in  $\varnothing$  oblong; stigmas 2–3 on conical top of ovary, erect or suberect,  $1/4$ – $1/3$  mm. *Utricle* falling off together with the perianth, about as long as this, only the subconical short beak emerging, very strongly corrugated,  $\pm 1\frac{1}{2}$  mm long, indehiscent or at last bursting irregularly. Seed with a blunt margin, shining brown or black,  $1$ – $1\frac{1}{4}$  mm diam.

Distr. Tropical ubiquitous, in *Malaysia*: throughout the Archipelago.

Ecol. In the lower regions, especially below 600 m alt., a very common weed of cultivated areas, also in waste places, locally often abundant. To my knowledge never cultivated in *Malaysia*.

Uses. In the Moluccas used as a food.

Vern. Besides the general name *bayam* many local names.

(1) Herbarium specimens have not rarely been collected before the utricles were quite ripe, sometimes when they were still very young. In such cases a normally circumscrib utricle often *seems* to burst irregularly (by pressure).

**2. *Amaranthus lividus* LINNÉ, Sp.Pl. 1 (1753) 990; THELLUNG in ASCH. & GR. Syn. 5, 1 (1914) 319; HEYNE, Nutt. Pl. (1927) 605; BACKER & SLOOT. Theconkr. (1924) 107, t. 107; BACKER, Onkr. Suiker. (1930) 220, Atl. t. 231.—*Amaranthus viridis* LINNÉ, Sp.Pl. ed. 2, 2 (1763) 1405, *ex parte*.—*Amaranthus blitum* (non L.) MIQ. Fl. Ind. Bat. 1 (1858) 1033; BTH. Fl. Austr. 5 (1870) 213; Hook. f. Fl. Br. Ind. 4 (1885) 721; OCHSE & BAKH. v. D. BR. Veget. (1931) 17, fig. 11.—*Euxolus lividus* MOQ. l.c. 273.**

Annual, erect of prostrate, 5–80 cm long, often much branched (frequently from very base), unarmed; stem terete-obtusangular, quite glabrous. *Leaves* (larger ones at least) rather long petioled, obovate or  $\pm$  rhomboid, rarely oblong, from cuneate base, with broadish, usually deeply emarginate mucronate apex, green or more or less suffused or blotched with purple or entirely purple; larger ones 3–6 by 2–4 cm. Lower flower-clusters axillary, higher ones on older vigorous plants always collected in terminal and axillary spikes or panicles; bracts and bracteoles ovate, acute, much shorter than adult perianth. Tepals 3, very shortly mucronate, with transparent margins and green or purple median band, very concave, in  $\sigma$  oblong,  $\pm 1\frac{1}{4}$  mm long, in  $\varphi$  oblong-spathulate, slightly accrescent with age,  $1\frac{1}{4}$ – $1\frac{1}{4}$  mm. Filaments equaling the perianth or slightly shorter. Rudimentary ovary in  $\sigma$  often present, filiform; ovary in  $\varphi$  oblong; stigmas 2–3, erect or suberect,  $\frac{1}{3}$ – $\frac{2}{3}$  mm long; adult *utricle* broadly ellipsoid, acute, laterally compressed, slightly exceeding perianth, smooth or faintly rugulose when ripe,  $1\frac{1}{2}$ –2 mm long, falling off together with perianth, indehiscent or at last bursting irregularly; seed wit a rather blunt margin, shining black or blackish brown,  $1$ – $1\frac{1}{4}$  mm diam.

*Distr. In Malaysia:* Sumatra, Java, Celebes & Philippines, probably also elsewhere.

*Ecol.* In Java from the lowlands up to  $\pm 2000$  m, a very common weed in cultivated and waste places.

*Uses.* Used by the Indonesians as a food.

*Vern.* *Bayam*. Moreover, many local names.

*Notes.* This is a very variable species.

**3. *Amaranthus interruptus* R.Br. Prod. (1810) 414; BTH. Fl. Austr. 5 (1870) 215; BAILEY, Queensl. Fl. pt 4 (1901) 1221.—*Amaranthus spiratus* ZIPP. *ex SPAN.* in Linnaea 15 (1841) 345, *nomen*.—*Euxolus interruptus* MOQ. in DC. Prod. 13, 2 (1849) 275; F.v.M. Descr. Not. pt 5 (1878) 87.**

Annual, erect or ascending, 40–60 cm long, almost simple or in higher part with (sometimes many) obliquely erect branches, unarmed; stem straight or slightly flexuous, obtusangular, glabrous or very thinly clothed with minute patent hairs. *Leaves* (larger ones at least) rather long petioled, oblong from long-cuneate base, much narrowed in upper half, obtuse or slightly emarginate, shortly mucronate, with oblique prominent primary lateral nerves; glabrous; larger leaves 3–6 by  $1\frac{1}{4}$ – $2\frac{1}{2}$  cm. *Flower-clusters* dense; lower ones axillary; higher ones collected in continuous or more or less inter-

rupted spike; terminal spike simple or branched; flowers in upper part of panicle-branches often exclusively  $\sigma$ , lower down largely or exclusively  $\varphi$ ; bracts and bracteoles shorter than perianth, mucronate on broadly oval transparent base. *Flowers* green, all of them (in the Timor-specimen) 5-merous. Tepals of  $\sigma$  oblong, acute or minutely mucronate,  $1\frac{1}{3}$ – $1\frac{1}{2}$  mm long; tepals of  $\varphi$  narrowly spathulate, very shortly mucronate, slightly accrescent with age,  $1\frac{1}{4}$ – $1\frac{3}{4}$  mm long. Styles 2–3, erect  $1\frac{1}{3}$ – $1\frac{1}{2}$  mm. *Utricle* falling off together with the perianth, broadly ellipsoid, rather thick, in a dried state faintly longitudinally ribbed and rugulose, tipped above the seed with a sharply delimited, broad, obtuse cone (bearing the unaltered styles), indehiscent or in dried materials bursting irregularly. Seed thick, with an obtuse margin, shining brownish black,  $\pm 1$  mm diam.

*Distr.* Eastern Australia, in *Malaysia:* Timor (SPANOGHE) and SE. New Guinea (LAWES; Port Moresby, CHALMERS, TURNER; Rigo distr. MACGREGOR).

*Notes.* Sometimes confused with unarmed forms of *Amaranthus spinosus* L. which may at once be recognized by the much longer ( $1\frac{1}{4}$ – $1\frac{1}{2}$  mm) styles. It has also been confused with *Amaranthus leptostachyus* BTH. which differs by the *circumsciss* smooth utricles.

**4. *Amaranthus tricolor* LINNÉ (sens. ampl.) Sp.Pl. (1753) 989; THELLUNG in ASCH. & GR. Syn. 5, 1 (1914) 272; MERR. Interpr. Herb. Amb. (1917) 213; En. Philip. Fl.Pl. 2 (1923) 128; HEYNE, Nutt. Pl. (1927) 606; BACKER, Onkr. Suiker. (1930) 220, Atl. t. 230; OCHSE & BAKH. v. D. BR. Veget. (1931) 25.—*Amaranthus melancholicus* LINNÉ, Sp.Pl. (1753) 989; MOQ. in DC. Prod. 13, 2 (1849) 262; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1032.—*Amaranthus mangostanus* LINNÉ, Cent. Pl. 1 (1755) 32; MOQ. in DC. Prod. 13, 2 (1849) 261; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1032; Hook. f. Fl. Br. Ind. 4 (1885) 720; MERR. Interpr. Herb. Amb. (1917) 213; En. Born. (1921) 245; RIDL. Fl. Mal. Pen. 3 (1924) 6; GAGN. in Fl. Gén. I.C. 4 (1936) 1062.—*Amaranthus polygamus* LINNÉ, Cent. Pl. 1 (1755) t. 32.—*Amaranthus gangeticus* LINNÉ, Syst. ed. 10, 2 (1759) 1268; MOQ. in DC. Prod. 13, 2 (1849) 261; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1032; Hook. f. Fl. Br. Ind. 4 (1885) 719; KOORD. Exk. Fl. 2 (1912) 196; RIDL. Fl. Mal. Pen. 3 (1924) 6; GAGN. in Fl. Gén. I. C. 4 (1936) 1063.—*Amaranthus oleraceus* (non LINNÉ) BURM. f. Fl. Ind. (1768) 198 (*sphalm.* 298); BLUME, Bijdr. (1825) 539; DECNE in Nouv. Ann. Mus. 3 (1834) 371; SPAN. in Linnaea 15 (1841) 345; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1033; Suppl. (1860) 149.—*Amaranthus salicifolius* HORT. VEITCH ex Gard. Chron. (1871) 1550, fig. 331; MERR. En. Philip. Fl.Pl. 2 (1923) 129.—Fig. 2.**

Annual; stem under cultivation erect and often very robust, up to  $1\frac{1}{2}$ – $2\frac{1}{2}$  m high, in a wild state usually much smaller, erect or ascending, angular, glabrous or in higher part thinly pubescent. *Leaves* (larger ones at least) long-petioled, rhomboid-ovate-oblong-lanceolate from a cuneate or acute, often decurrent base, narrowed in upper part, acute,

obtuse, rounded, retuse or emarginate, glabrous or on larger nerves thinly pubescent, in wild specimens entirely green, in cultivated (for orna-

ment) forms often tinged or blotched with purple or entirely purple, sometimes bright red with yellow; larger leaves 10–25 by 3–12 cm. *Flower-clusters* dense; lower ones axillary, higher ones often collected in rather thick spike; ♂ and ♀ flowers intermixed; bracts and bracteoles long-awned from broad base, as long as adult perianth or shorter. Tepals 3, long-awned from broad base, with broad transparent margins and green or purple median band, in ♂  $3\frac{1}{2}$ –6 mm long, in ♀ at first 2–3 mm, under the ripe fruit 3–5 mm. Filaments about as long as perianth or shorter, often much shorter; ovary cylindrical or obconical; styles 3, 2–2½ mm long. *Utricle* flask-shaped, circumsciss somewhat below middle; lid with thickened base and suddenly contracted, conical, obtuse apex. Seed with a rather obtuse margin, shining blackish brown or brown, 1–1¼ mm diam.

Distr. Ubiquist, possibly native in trop. Asia, in *Malaysia*: throughout the Archipelago.

Ecol. Very frequently cultivated as a pot-herb, often run wild in waste places, in fields, along roadsides, locally often abundant, 1–700 m.

Uses. Cultivated green-leaved forms very frequently eaten by Europeans and non-Europeans as a substitute for spinach. Variegated-leaved forms sometimes kept in gardens as ornamentals.

Vern. *Bayam*. Moreover, local names.

**5. *Amaranthus spinosus* LINNÉ, Sp.Pl. (1753) 991; BURM. f. Fl. Ind. (1768) 200 (*sphalm.* 300); BLUME, Bijdr. (1825) 540; DECNE, Nouv. Ann. Mus. 3 (1834) 371; BLANCO, Fl. Filip. (1837) 710; ed. 2 (1845) 491; ed. 3, 3 (1879) 113; SPAN. in Linnaea 15 (1841) 345; HASSK. Pl. Jav. Rar. (1848) 432; MOQ. in DC. Prod. 13, 2 (1849) 260; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1031; HOOK. f. Fl. Br. Ind. 4 (1885) 718; KOORD. Minah. (1898) 564; BAILEY, Queensl. Fl. pt 4 (1901) 1220; KOORD. Exk. Fl. 2 (1912) 195; THELLUNG in ASCH. & Gr. Syn. 5, 1 (1914) 267; MERR. Interpr. Herb. Amb. (1917) 213; EN. BORN. (1921) 245; EN. PHILIP. Fl.Pl. 2 (1923) 128; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 629; RIDL. Fl. Mal. Pen. 3 (1924) 6; HEYNE, Nutt. Pl. (1927) 606; BACKER, Onkr. Suiker. (1930) 220, Atl. t. 229; OCHSE & BAKH. v. d. Br. Veget. (1931) 23; GAGN. in Fl. Gén. I.C. 4 (1936) 1062.**

Annual, erect, often much branched, 15–100 cm high; stem terete or obtusangular, green or more or less suffused with purple, glabrous or slightly pubescent. *Leaves* (larger ones at least) rather long petioled, ovate-oblong-lanceolate, from acute, often slightly decurrent base, in their upper part gradually narrowed, obtuse, rounded or slightly retuse, often shortly mucronate, glabrous or, when young, slightly pubescent on the nerves; larger ones  $3\frac{1}{2}$ –11 by  $1\frac{1}{4}$ –4½ cm. *Flower-clusters* dense; lower ones axillary; higher ones often collected in axillary and terminal spikes; spikes often branched in their lower part; terminal spike above base usually wholly ♂, with weak spines or quite unarmed, finally often with a drooping apex; axillary clusters and those on the base of the spike (rarely also the higher ones) usually armed with 2, or sometimes more, obliquely erect or patent, straight, thin, very



Fig. 2. *Amaranthus tricolor* L. from Java,  
× 1/6.



sharp,  $1\frac{1}{2}$ –2 cm long spines (metamorphosed bracts), sometimes with one spine only, rarely (*var. inermis* SCHINZ) unarmed; bracts and bracteoles mucronate from a broad base, shorter than the adult perianth or at best as long. *Tepals* 5, shortly mucronate, very convex, with transparent margins and green or purple median band, in ♂ ovate-oblong, 2–2½ mm long, in ♀ oblong-spathulate, at first 1¼–1½ mm, under the ripe fruit 1¾–2¾ mm long. Filaments about equalling perianth or slightly longer or shorter. Ovary oblong; styles mostly 3, sometimes 2, when adult recurved and 1¼–1½ mm long. *Utricle* oblong, with a 3-lobed apex, circumsciss a little below the middle. Seed with a thin margin, shining black or brownish black,  $\pm$  1 mm diam. or slightly larger.

*Distr.* Ubiquist, in *Malaysia*: throughout the Archipelago.

*Ecol.* At present throughout Java, from the lowlands up to  $\pm$  1400 m, a very common weed of waste places, railway-yards, waysides, fields and gardens, often gregarious.

*Uses.* Used as a diuretic, an emmenagogue and a lactagogue, further for poultices and against gonorrhea.

*Vern.* *Bayam duri* (i.e. spinous bayam). More-over many local names.

*Notes.* Possibly an introduced species. In Malaysian specimens ripe adult utricles always open circumsciss a little below the middle.

**6. *Amaranthus leptostachyus* BTH.** Fl. Austr. 5 (1870) 214; BAILEY, Queensl. Fl. part 4 (1901) 1220; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1921) 630.

Annual, not or sparingly branched,  $7\frac{1}{2}$ –25 mm high; stem obtusangular, glabrous or very sparingly beset with patent minute hairs. *Leaves* (larger ones at least) long petioled, ovate-oblong from a cuneate base, in their upper part gradually narrowed to an obtuse or acute, minutely mucronate apex, glabrous or beneath on the nerves with few scattered, very minute, patent hairs, 1–6 by  $\frac{1}{3}$ –2½ cm; primary nerves in dried specimens distinctly prominent beneath; petiole  $\frac{1}{4}$ –6 cm. *Flower-clusters* rather dense; lower ones axillary, consisting almost or entirely of ♀ flowers; higher clusters collected in axillary and terminal spikes, often forming together a terminal panicle, consisting mainly of ♂ flowers, in the lower part often intermixed with ♀ ones; bracts and bracteoles mucronate, shorter than the perianth. *Tepals* usually 4–5, sometimes 3, erect or obliquely patent, oblong-spathulate with a distinct mucro, scarious with a conspicuous but rather thin green midrib,  $1\frac{1}{3}$ –1½ mm long,  $\frac{1}{3}$ –½ mm wide. Stamens in ♂ 4–5, not rarely 3. Styles in ♀ 2–3, erecto-patent or recurved,  $\frac{1}{3}$ –½ mm long. *Utricle* tipped by a thick conical beak, crowned by the styles, not rugulose, circumsciss; upper part falling away, leaving the much shorter cup-shaped persistent base in the perianth. Seed erect, lenticular, shining blackish brown, somewhat less than 1 mm diam.

*Distr.* N. Australia, in *Malaysia*: SE. New Guinea (Lorne Range, CHALMERS; Jimari, FITZGERALD).

*Notes.* Sometimes confused with *A. interruptus* R.Br. which may be easily recognized by the indehiscent, in a dry state slightly rugulose utricle and constantly 5-merous flowers. From unarmed forms of *A. spinosus* L. easily distinguishable by the much shorter styles (in *A. spinosus* 1¼–1½ mm).

**7. *Amaranthus dubius* MART.** Hort. Erl. (1814) 197; THELL. in ASCH. & GR. Syn. 5, 1 (1914) 265.

Annual, erect,  $\frac{1}{2}$ –1 m high, in its upper part often with many obliquely erect branches, unarmed; stem obtusangular, green, glabrous or very thinly beset with minute patent hairs. *Leaves* (larger ones at least) long-petioled, ovate-oblong or ovate-rhomboid from broadly cuneate base, much narrowed in the upper part, slightly emarginate, minutely mucronate, glabrous; larger leaves 6–20 by 4–10 cm. *Flowers-clusters* dense, green, lowest axillary; higher ones collected in dense spikes; spikes (especially the terminal ones which frequently reach 10–25 cm in length) in their lower part frequently with few or many obliquely patent branches, often sinuous, either almost entirely ♂ or at base ♂, higher up ♀; terminal spike often entirely ♀; larger bracts broad, thinly membranous, oval with a long mucro, totalling  $\pm$  2 mm. *Perianth* 1½–2½ mm long; that of the ♀ flowers somewhat increasing with age; tepals 4–5, rarely 3, oval-oblong; their midrib in lower half very thin, in upper half (up to quite near apex) much thickened, produced into a short (often very short) mucro. Filaments short. Ovary shortly 3-lobed; styles 3, 1–1¼ mm long, often recurved. *Utricle* ellipsoid, when fully ripe circumsciss in or slightly below middle. Seed with a rather thin margin, brownish black, shining  $\pm$  1½ mm diam.

*Distr.* Native of tropical America, of rather recent introduction in Java; collected for the first time in 1922 and repeatedly afterwards at Buitenzorg, later also at Bandoeng. Not yet found in any other part of Malaysia.

*Ecol.* Weed of gardens, road-sides and waste places, abundantly fruiting, may be expected to spread rapidly.

**8. *Amaranthus hybridus* LINNÉ subsp. *cruentus* (L.) THELL. var. *paniculatus* (L.) THELLUNG in ASCH. & GR. Syn. 5, 1 (1914) 247; HEYNE, Nutt. Pl. (1927) 605; BACKER, Onkr. Suiker. (1930) 219, Atl. t. 228.—*Amaranthus hybridus* L. Sp.Pl. (1753) 990.—*Amaranthus cruentus* LINNÉ, Syst. Pl. ed. 10, 2 (1759) 1269, non WILLD. ex ROXB. quod est *A. caudatus* L.—*Amaranthus paniculatus* LINNÉ, Sp.Pl. ed. 2 (1763) 1406; Moq. in DC. Prod. 13, 2 (1849) 257; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1030; BTH. Fl. Austr. 5 (1870) 213; HOOK. f. Fl. Br. Ind. 4 (1885) 718; BAILEY, Queensl. Fl. pt 4 (1901) 1220; KOORD. Exk. Fl. 2 (1912) 196; MERR. En. Philip. Fl.Pl. 2 (1923) 128; GAGN. in Fl. Gén. I.C. 4 (1936) 106.—*Amaranthus speciosus* SIMS, Bot. Mag. (1821) t. 2227.**

Annual, erect, in higher part often much branched, 0.15–3 m, unarmed; stem obtusangular, strongly suffused with purple; younger parts more or less



densely clothed with short hairs or almost glabrous. *Leaves* (larger ones at least) long-petioled, ovate-oblong-lanceolate from an acute often short-decurrent base, in their upper half gradually narrowed, obtuse, shortly mucronate, often with wavy margins, dark green above, strongly tinged with purple beneath; larger ones 10–30 by 3–12 cm; nerves beneath or on both sides more or less densely hairy. *Flower-clusters* crowded, paniculate or in feeble specimens spicate; panicles (spikes) terminal and frequently also in the higher leaf axils, erect or at the top more or less drooping, puberulous, (♂♂); terminal panicle in well-developed specimens 15–40 cm long. *Flowers* dark purple, 5-merous; bracts and bracteoles long-pointed distinctly longer than perianth. Tepals oblong, not or hardly overlapping, with a short or very short mucro,  $1\frac{1}{3}$ – $1\frac{1}{2}$  mm wide, in ♂  $1\frac{3}{4}$ –2 mm long, in ♀ during anthesis (mucro excluded)  $1\frac{1}{3}$ – $1\frac{1}{2}$  mm long, afterwards up to 2 mm. Filaments white, equalling perianth or slightly longer. Ovary in ♂ rudimentary, hardly perceptible, in ♀ oblong; styles 3, less often 2, ± recurved, ±  $\frac{3}{4}$  mm long; *utricle* exceeding perianth, ± urceolate, in the lower half pale, in the upper half purple, circumsciss between the pale and the purple parts. Seed dark brown, shining, 1– $1\frac{1}{4}$  mm diam.

*Distr.* Native country unknown, introduced into *Malaysia* very long ago: Sumatra, Java, Lesser Sunda Islands.

*Ecol.* In Java from the lowlands up to ± 1300 m cultivated for ornamental purposes and sometimes met with as a stray from gardens, but nowhere firmly established, not truly naturalized.

*Uses.* in *Malaysia* unknown.

*Vern.* *Bayam kéjong*, J, and a few local names.

9. *Amaranthus caudatus* LINNÉ, Sp.Pl. (1753) 990; MOQ. in DC. Prod. 13, 2 (1849) 255; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1030; HOOK. f. Fl. Br. Ind. 4 (1885) 719; BAILEY, Queensl. Fl. pt 4 (1901) 1220; KOORD. Exk. Fl. 2 (1912) 196; THELLUNG in ASCH. & GR. Syn. 5, 1 (1914) 231; RIDL. Fl. Mal. Pen. 3 (1924) 6; GAGN. in Fl. Gén. I.C. 4 (1936) 1061.

Annual, erect, not or sparingly branched, 0.3– $1\frac{1}{2}$  m, unarmed; stem obtusangular, usually suffused with purple, thinly beset with patent short hairs. *Leaves* (larger ones at least) long petioled, rhomboid-ovate-lanceolate from cuneate base, in their upper half gradually narrowed, obtuse, mucronate, green, often bordered with purple; dimensions?; nerves beneath usually pale. *Flower-clusters* very densely spicate; lower panicle; panicle in *Malaysian* specimens borne by a flaccid peduncle, drooping from the very base; terminal spike frequently much longer than the others; bracts and bracteoles broad, with a long apical point; many slightly exceeding the flowers. Perianth 5-merous. *Tepals* in ♂ ovate-oblong, shortly mucronate, in ♀ oblong-obovate-subspathulate, with at least partly overlapping margins, 2– $2\frac{1}{2}$  mm (including the often rather long mucro) by  $\frac{2}{3}$ – $\frac{3}{4}$  mm, purple. Styles 3, ±  $\frac{3}{4}$  mm long. *Utricle* slightly exceeding perianth, lageniform, circumsciss. Seed 1– $1\frac{1}{4}$  mm diam; dark brown, shining.

*Distr.* Ornamental plant of old, native country not known with certainty, in *Malaysia* but rarely cultivated.

*Notes.* The only *Malaysian* specimen I have seen had been collected in NE. Sumatra above Sibolangit, ± 1350 m; it may have been taken from a cultivated plant.

## 5. DIGERA

FORSK. Fl. Aeg.–Arab. (1775) 65.

Annual. *Leaves* alternate, petioled, entire or subentire. *Flowers* in axillary peduncled spiciform racemes; lower part of raceme in each axil of persistent bracts with 3 flowers on very short common stalk; central flower of triad perfect, ♀, 2-bracteolate; tepals 5, almost free; 2 outer ones larger than the 3 other ones and together embracing them. Stamens 5; filaments free, filiform; no pseudo-staminodes; anthers oblong, 2-celled (4-locellate). Ovary obovoid, truncate; ovule 1, erect; style filiform, rather long; stigmas 2, recurved, linear, short. Lateral flowers in the axil of bracteoles of the fertile flower, reduced to a stalked palmatifid scale; scales towards the apex of the raceme gradually smaller, in the highest flowers absent. *Utricle* falling off together with the enclosing perianth, bracteoles and scales, rugulose-tuberculate, with keeled sides ending at the top in a small hornlet, crustaceous, indehiscent. Seed erect, exarillate.

*Distr.* Monotypic; northern Africa through the Orient and S. Asia to *Malaysia*.

*Notes.* In feeble specimens the sterile lateral flowers are sometimes absent.

1. *Digera muricata* (L.) MART. Beitr. Amar. (1825) 77, no 2.—*Achyranthes muricata* LINNÉ, Sp.Pl. ed. 2 (1762) 295.—*Achyranthes alternifolia* LINNÉ, Mant. (1767) 50; ROXB. Fl. Ind. ed. CAREY 1 (1832) 674.—*Digera arvensis* FORSK. Fl. Aeg.–Arab. (1775)

65; MOQ. in DC. Prod. 13, 2 (1849) 324; HASSK. in Pl. Jungh. (1852) 132; ZOLL. Syst. Verz. (1854) 109; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1044; HOOK. f. Fl. Br. Ind. 4 (1885) 717; KOORD. Exk. Fl. 2 (1912) 197.—*Cladostachys frutescens* D. DON, Prod.

(1825) 76; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1025.—*Digera forskooli* BL. Bijdr. (1825) 542; HASSK. Pl. Jav. Rar. (1848) 425; MOR. Syst. Verz. (1845/6) 73; ZOLL. Syst. Verz. (1854) 109.—*Desmochaeta muri-*

*cata* WIGHT, Icon. (1843) t. 732.—*Cladostachys muricata* MOQ. in DC. Prod. 13, 2 (1849) 235.—*D. alternifolia* ASCH. in SCHWEINF. Beitr. Fl. Aeth. (1867) 180; ASCH. & GR. Syn. 5, 1 (1914) 357; BACKER, Onkr. Suiker. (1930) 223; Atl. t. 233.—Fig. 3.

Annual, often branched from base; small specimens erect; larger ones prostrate-ascending or with widely patent, prostrate-ascending, often long branches, 0.15–1.6 m long; stem often flexuous, glabrous or slightly pubescent. *Leaves* ovate or ovate-oblong from a cuneate, obtuse, rounded or subcordate base, with an acute, obtuse or rounded apex, entire or obsoletely crenulate, herbaceous, glabrous,  $1\frac{1}{2}$ – $7\frac{1}{2}$  by  $\frac{3}{4}$ – $5\frac{1}{2}$  cm; petiole  $\frac{3}{4}$ –5 cm. *Racemes* solitary, widely patent-ascending, in upper part dense, lower down rather lax, 1–30 cm long ( $\frac{1}{4}$ – $7\frac{1}{2}$  cm of peduncle included), glabrous or subglabrous; lowest fruits often falling off before expansion of the highest flowers; bracts widely patent, ovate-lanceolate, concave with a strong midrib and broad scarious margins, glabrous (as are pedicels, bracteoles, scales and perianth),  $2\frac{1}{2}$ –3 mm long, persistent; pedicels very short; bracteoles appressed against sterile flowers or in the absence of these against the perianth, oblong with scarious margins, 2– $2\frac{1}{2}$  mm long. Sterile flowers appressed against the fertile flower, flat, much dilated from a stalk-like base, palmatifid, towards the apex of the raceme gradually smaller, in the highest flowers absent. *Tepals* during anthesis more or less patent, afterwards erect; 2 outer ones  $3\frac{1}{2}$ – $4\frac{1}{4}$  mm long, concave, 5–7-nerved, green with whitish or pink borders; 3 inner ones shorter, much narrower, thinner, obtuse, pink, 1–2-nerved. Adult filaments much longer than anthers. Style (short stigmas excluded) 2– $2\frac{1}{2}$  mm; perianth after anthesis not or hardly accrescent. *Fruit* compressed-globose, between the apical hornlets slightly depressed, bearing a persistent style-base, 2– $2\frac{1}{4}$  mm diam.

Distr. N. Africa through the Orient to southern Asia, in *Malaysia*: Java, Madura, Kangean Arch., Celebes, Moluccas, Sumba and Sumbawa.

Ecol. Obviously preferring the drier areas, 1–250 m, in fields (especially when sandy), along road-sides, railway-embankments, waste places, usually in scattered specimens.

Vern. *Bayam sidit*, J.

Notes. The specimen preserved in BURMAN's collection (Herb. DELESSERT, Geneva) named *Achyranthes muricata* and mentioned in BURM. f. Fl. Ind. (1768) 63 is *Amaranthus gracilis* DESF. The true *Digera muricata* lies in Herb. BURMAN as '*Blitum, malaice Baian clatek*' (*bajam glatik*).



Fig. 3. *Digera muricata* (L.) MART. from Java,  $\times \frac{1}{4}$ .

## 6. CYATHULA

BLUME, Bijdr. 11 (1825) 548, *nom. conserv.*, non LOUR.

Perennial herbs or undershrubs. *Leaves* opposite, entire. *Flowers* clustered; clusters either singly along the rachis of a long raceme on short, jointed stalks, deflexed after anthesis, or (not in *Malaysia*) in dense globose heads; perfect flowers in each cluster 1–3, ♀, at least partly accompanied by imperfect sterile ones (reduced to

fascicled hooks. *Tepals* of perfect flowers 5, oblong, shortly acuminate, with scarious margins, longitudinally nerved. Stamens 5; filaments at the base connate into a short cup; free parts alternating with shorter, dentate or lacerate pseudo-staminodes; anthers 2-celled (4-locellate). Ovary obovoid; ovule 1, pendulous from a long funicle; style filiform; stigma capitellate. *Utricle* ellipsoid, thin-walled, indehiscent, by means of the hooks easily adhering to passers-by.

Distr. Pantropic, probably two dozen species, centering in Africa, in *Malaysia* only one widely distributed species and an endemic variety.

#### KEY TO THE SPECIES

1. Leaves rhomboid-obovate or rhomboid-oblong; larger ones less than twice as long as broad.

#### 1. *C. prostrata*

1. Leaves lanceolate or linear-lanceolate; larger ones more than 2½ times as long as broad.

#### 1. *C. prostrata* var. *lancifolia*

**1. *Cyathula prostrata* (L.) BLUME**, Bijdr. (1825) 549; MOQ. in DC. Prod. 13, 2 (1849) 326; HASSK. in Pl. Jungh. 2 (1852) 133; HOOK. f. Fl. Br. Ind. 4 (1885) 723; BAILEY, Queensl. Fl. 4 (1901) 1230; KOORD. Exk. Fl. 2 (1912) 197; MERR. Fl. Man. (1912) 194; Interpr. Herb. Amb. (1917) 214; EN. BORN. (1921) 246; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 639; BACKER, Trop. Natuur 11 (1922) 81, *cum ic.*; MERR. En. Philip. Fl. Pl. 2 (1923) 129; RIDL. Fl. Mal. Pen. 3 (1924) 7; HEYNE, Nutt. Pl. (1927) 606; BACKER, Onkr. Suiker. (1930) 224, Atl. t. 234; GAGN. in Fl. Gén. I.C. 4 (1936) 1070.—*Achyranthes prostrata* LINNÉ, Sp. Pl. ed. 2 (1762) 296; BURM. Fl. Ind. (1768) 64.—*Pupalia prostrata* MART. Beitr. Amar. (1825) 113; HASSK. Pl. Jav. Rar. (1848) 427.—*Cyathula geniculata* (non LOUR.) MIQ. Fl. Ind. Bat. 1, 1 (1858) 1045; KOORD. Minah. (1898) 565.—Fig. 4.

Perennial herb, ascending or erect from a rooting base, 30–50 cm high; stem obtusely quadrangular, thickened above the nodes, often tinged with red, rather densely clothed with fine hairs. *Leaves* rhomboid-obovate or rhomboid-oblong from a contracted or narrowed, rounded, obtuse or acute base and a mostly triangular, acute or rather obtuse apex, entire, ciliate, bordered with red, otherwise green or, especially in a young state, more or less tinged with red, herbaceous, on both surfaces more or less densely patently hairy, 1¼–15 by ¾–6½ cm; petiole 1–12 mm. *Flowers* racemed; racemes terminal and often also in the highest leaf-axils, erect, straight or ± sinuous, 19–45 cm (including 1–12 cm peduncle); rachis rather densely pubescent; bracts ovate, acuminate very acute, reflexed after anthesis; clusters shortly stalked, in the lower part of the inflorescence more or less distant, in the higher part crowded, at first erect, afterwards patent, at last reflexed; lower clusters composed of 2–3 perfect ♂ flowers and several imperfect sterile ones; imperfect flowers towards the



Fig. 4. *Cyathula prostrata* (L.) BL. from Java,  $\times 1/3$ .

apex of inflorescence gradually fewer; apex of inflorescence bearing solitary perfect flowers without imperfect ones; stalks of clusters joined just above the base; ripe clusters falling off as a whole. *Tepals* of ♂ ovate-oblong, strongly mucronate,  $2\frac{1}{4}$ –3 mm long, dull pale green, glabrous within, externally clothed with appressed or patent, rather long, white hairs; outer ones 5-, inner ones 3–4 nerved. Free parts of the filaments  $\pm$  1 mm; anthers minute; pseudo-staminodes rectangular-cuneate with a truncate, shortly dentate apex. Ovary with a broad, flat top; style  $\pm$   $\frac{2}{3}$  mm. Utricle glabrous  $\pm$   $1\frac{1}{2}$  mm; seed shining brown. Imperfect flowers  $1\frac{3}{4}$ – $2\frac{1}{2}$  mm long, sessile or almost so; hooks obliquely patent, above the hairy base glabrous and usually red.

Distr. Africa to China and Australia, prob. introduced in Central America, in *Malaysia*: throughout the Archipelago.

Ecol. In the settled areas, 1–1650 m, common in shaded localities, along roadsides, teak-forests, forest-borders, secondary forests, often gregarious.

Uses. Used for some medicinal purposes, against cough, dysentery, cholera and intestinal worms.

Vern. *Rumput djarang-djarang*, M, *ranggitan*, J, and several local names.

Notes. The type specimen of *Cyathula geniculata* LOUR. is *Achyranthes aspera* L.

var. **lancifolia** (MERR.) comb. nov.—*Cyathula lancifolia* MERR. in Philip. J.Sc. 11 (1916) Bot. 179; En. Philip. Fl.Pl. 2 (1923) 129.—*C. lancifolia* var. *stenophylla* MERR. in Philip. J.Sc. 29 (1926) 478.

Leaves lanceolate or linear-lanceolate from a narrowed, acute base, towards the apex tapering or slightly acuminate, acute or rather obtuse, apiculate, entire, ciliate, herbaceous, on both surfaces rather thinly clothed with appressed long thin hairs or, barring the nerves, subglabrous beneath,  $1\frac{1}{2}$ –7 by  $\frac{1}{3}$ – $2\frac{1}{2}$  cm; petiole  $\frac{1}{4}$ – $\frac{1}{2}$  cm.

Distr. *Malaysia*: Philippines (Luzon, Samar, Bohol, Mindanao).

Ecol. Damp forests at low and medium altitudes.

Notes. Except the narrow leaves I can find no differences with the species; there are no transitions. MERRILL's var. *stenophylla* is apparently a dwarf, characterized by a much slenderer habit and short racemes 5–10 cm long incl. the peduncle.

## 7. PUPALIA

JUSS. in Ann. Mus. 2 (1803) 132, *nomen conserv.*; MOQ. in DC. Prod. 13, 2 (1849) 331.

Herbs, sometimes woody at the base. *Leaves* opposite, entire. Flowers spicate or racemed; spikes (racemes) terminal and axillary; lower part of spike (raceme) in axils of persistent bracts with a flower-cluster consisting of 2–3 bibracteolate ♀ flowers accompanied by some rudimentary ones; highest flowers often solitary and ♂, without rudimentary flowers. *Tepals* 5, free, with scarious margins, 3–5-nerved, not indurate at base. Stamens 5, at the base connate in a very short cup; no pseudo-staminodes; anthers oblong, 2-celled (4-locellate). Ovule 1, pendulous from a long funicle; style filiform; stigma capitate. *Utricle* oblong-obovoid, subcompressed; pericarp thin with a sharply delimited somewhat thicker apex, which finally falls off letting out the seed; rudimentary flowers consisting of fascicled squarrose hooks; clusters falling off (with the bracteoles) as a whole, by means of the hooks, readily and firmly adhering to passers-by.

Distr. Few spp., from Africa to India and Malaysia.

**1. *Pupalia lappacea*** (L.) JUSS. in Ann. Mus. 2 (1803) 132; MOQ. in DC. Prod. 13, 2 (1849) 331; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1046; HOOK. f. Fl. Br. Ind. 4 (1885) 724; FORB. Wand. (1885) 515. KOORD. Exk. Fl. 2 (1912) 198; MERR. in Philip. J. Sc. 11 (1916) Bot. 269; En. Phil. Fl.Pl. 2 (1923) 129.—*Achyranthes lappacea* LINNÉ. Sp.Pl. (1753) 204; ROXB. Fl. Ind. ed. CAREY (1832) 673.—*Achyranthes atropurpurea* LAMK. Enc. 1 (1785) 346.—*Pupalia atropurpurea* MOQ. l.c. 331; ZOLL. Syst. Verz. (1854) 109; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1046; HOOK. f. Fl. Br. Ind. 4 (1885) 723; FORB. Wand. (1885) 515; KOORD. l.c. 198.—*Desmochaeta atropurpurea* DC. and *D. flavesces* DC. ex Cat.

Hort. Monsp. (1813); DECNE in Nouv. Ann. Mus. 3 (1834) 372; SPAN. in Linnaea 15 (1841) 345.

Perennial herb, erect or clambering, often much branched,  $\frac{1}{2}$ –2 m high; stem obtusely quadrangular or 'subterete, thickened above the nodes, finely pubescent. *Leaves* ovate-oblong from a rounded, obtuse or acute base, contracted into the petiole, acutely acuminate, on both surfaces glabrous or more or less densely clothed with shorter or longer, appressed or obliquely patent, white hairs, 2–12 by  $1\frac{1}{4}$ –7 cm; petiole 2–25 mm, finely pubescent. *Spikes* (racemes) terminal and in the highest leaf axils, erect or obliquely erect,

6–35 cm long (1–10 cm peduncle included), finely and more or less densely patently pilose. *Flower*-clusters sessile or very shortly stalked, lower remote, higher ones crowded, all clusters at first erect, afterwards patent, consisting of 2–3 ♂ flowers and several rudimentary ones; highest ♀ flowers solitary without accompanying rudimentary flowers; bracts and bracteoles ovate-oblong, acute, pilose; bracts  $2\frac{1}{2}$ –5 mm long, soon widely patent or reflexed; bracteoles  $2\frac{1}{2}$ –4 mm. *Tepals* oblong or ovate-oblong, with a short acicular apical point, 4–5 mm long, dull pale green, albedo-pilose outside, inside glabrous. Staminal cup  $\frac{1}{3}$ – $\frac{1}{2}$  mm high, slightly fleshy; free parts of the filaments  $\pm$  2 mm, often pink; anthers  $\pm$   $\frac{1}{2}$  mm. Ovary with a narrow base and a clearly delimited broadly

rounded apex; style  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm. *Utricle* 2– $2\frac{1}{2}$  mm long; seed shining dark brown; rudimentary flowers at first subsessile and small, afterwards borne on a distinct, villous pedicel and much accrescent; hooks finally 3–4 mm long, pale green or purple, glabrous above the villous base.

Distr. Africa to India, in *Malaysia*: eastern part of Java, Madu. a, Bali, Kangean Arch., Philippines, Celebes, Saleier, Lombok, Sumba, Sum-bawa & New Guinea.

Ecol. Distinctly preferring the periodically dry areas, 3–300 m, in sunny or slightly shaded localities, grassy wilds, jungles, hedges, teak-forests, in many regions rather common but usually as scattered specimens.

Vern. *Djembrengan*, J, *tjaki*, J.

### 8. AERVA (*Aerua* AUCTT.)

FORSK. Fl. Aeg.–Arab. (1775) 170, *nomen conserv.*

Herbs or undershrubs, erect, straggling or clambering. *Leaves* alternate or opposite, quite entire. *Flowers* in axillary and terminal spikes, small ♂ or (♀) (♀), solitary in the axil of a persistent bract, sustained by 2 bracteoles: the latter either falling off with the perianth or not; rachis of the spike remaining whole after fruiting, or breaking up. *Tepals* 5, free, thin and tender or rather firm, hairy, 1- or more-nerved. *Stamens* 5; filaments at base connate in a short cup; free parts subulate, alternating with shorter, subulate, pseudo-staminodes; anthers 2-celled (4-locellate). Ovary compressed, glabrous; ovule 1, pendent from apex of long funicle; style very short, stigmas 1–2. *Utricle* falling off with the perianth, much compressed, bursting irregularly. Seed vertical, reniform, shining black.

Distr. About 10 spp. in the Old World, centering in Africa.

Notes. *Aerva javanica* (BURM. f.) JUSS. does not occur in Java, nor for that matter elsewhere in Malaysia. It is reduced to the African-Asian *Aerva persica* (BURM. f.) MERR.

#### KEY TO THE SPECIES

1. Spikes very dense. *Tepals* very thin, 1-nerved, externally clothed with many long white hairs, often densely woolly. Bracteoles *not* falling off together with the fruiting perianth.
2. Stigmas 2, very distinct, shortly linear, obliquely spreading. Spikes for the greater part  $\frac{1}{2}$ – $2\frac{1}{2}$  cm long, with a usually rounded apex, mostly 2–4 together in the axils of normal leaves, never forming a loosely branched panicle. *Tepals*  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm. Leaves  $\frac{1}{2}$ –5 by  $\frac{1}{4}$ –3 cm. Erect herb, 10–110 cm high.
2. Stigma 1, entire or very obscurely 2-lobed with broadly rounded lobes. Spikes  $\frac{3}{4}$ –5 cm long, usually with a conical apex, partly in the axils of ordinary leaves, partly in the axils of bracts, often forming a  $\pm$  paniculate inflorescence. *Tepals* 2– $2\frac{1}{2}$  mm. Leaves  $1\frac{1}{2}$ – $7\frac{1}{2}$  cm. Erect or more or less clambering,  $\frac{3}{4}$ –2 m high.
1. Spikes *not* very dense. *Tepals* rather firm, 3–5-nerved, externally thinly beset with very short hairs. Bracteoles falling off together with the fruiting perianth. Bract-bearing rachis remaining whole for a long time after the fall of the flowers.

#### 1. *Ae. lanata*

#### 2. *Ae. sanguinolenta*

#### 3. *Ae. curtisii*

1. *Aerva lanata* (L.) JUSS. in Ann. Mus. Paris 11 (1808) 131; BLUME, Bijdr. (1825) 547; HASSK. Pl. Jav. Rar. (1848) 423; MOQ. in DC. Prod. 13, 2 (1849) 303; HASSK. in Pl. Jungh. (1852) 132; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1039, Suppl. (1860) 149, 365; HOOK. f. Fl. Br. Ind. 4 (1884) 728; PULLE in Nova Guinea 8 (1910) 352; KOORD. Exk. Fl. 2 (1912) 198; MERR. En. Philip. Fl. Pl. 2 (1923) 130; HEYNE, Nutt. Pl. (1927) 607; BACKER, Onkt. Suiker. (1930) 225, Atl. t. 235.—*Achyranthes lanata* LINNÉ, Sp. Pl. (1755) 204.—Fig. 5.

Perennial erect herb, 10–110 cm long, often di-

vided from near the base into ascending or erect branches; main branches and upper part of the stem often unbranched for a considerable length, leafy and flowering almost throughout; stems terete, hard, densely clothed with appressed and patent white hairs; internodes usually shorter than 2 cm. *Leaves* alternate, oval-elliptic-obovate from a cuneate or contracted base, acute or rather obtuse, with a very short mucro, on both surfaces (especially so beneath) rather densely appressed white-pubescent, 6–50 by 3–30 mm; highest leaves often very small; petiole 2–15 mm. *Spikes* mostly

2-4 together, patent or obliquely erect, cylindric with a usually rounded apex, pure white,  $1/2-1\frac{1}{2}$  cm, sometimes up to  $2\frac{1}{2}$  cm long; highest often collected into a dense leafless inflorescence, but never forming a loosely branched panicle. *Flowers* softly membranous; all ♂; bracts and bracteoles ovate-oval, mucronate, white, externally hairy,  $3/4-1$  mm long. *Tepals*  $1\frac{1}{3}-1\frac{1}{2}$  mm, densely white-woolly outside, oval-oblong, rounded or very obtuse; 2 outer ones with minute mucro, entirely white, 3 others with green midrib. *Stamens*  $\pm$  half as long as perianth; style totalling  $1/4-1\frac{1}{3}$  mm, bifid

nearly halfway down; arms very distinct, obliquely spreading, shortly linear. *Utricle*  $\pm 1$  mm diam. Seed  $2/3-3/4$  m. Fruiting spike easily breaking up (in a dried state). Graceful plant!

*Distr.* Africa to Asia, in *Malaysia*: Sumatra, Banka, Java, Madura, Philippines, Aru Isl., Timor, and New Guinea.

*Ecol.* Especially in periodically dry areas, in Java  $1/2-100$  m, in dry localities, along roadsides, on neglected premises, waste places, locally often frequent.

*Uses.* Leaves steeped in hot water used as a remedy against sudden swellings.

*Vern.* Katumpangan ayer, M.

*Notes.* The sheet conserved under the name *Achyranthes lanata* in Herb. BURMAN at Geneva is *Ae. sanguinolenta* (L.) BL. A second specimen of *Ae. sanguinolenta* in the Herb. BURMAN bears the wrong name of *Celosia lanata* L. (= *Aerva javanica* JUSS.).

2. *Aerva sanguinolenta* (L.) BL. Bijdr. (1825) 547; DECNE in Nouv. Ann. Mus. 3 (1834) 371; SPAN. in Linnaea 15 (1841) 345; MOQ. in DC. Prod. 13, 2 (1849) 300; HASSK. in Pl. Jungh. (1851) 132; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1038; KOORD. Exk. Fl. 2 (1912) 198; MERR. Interpr. Herb. Amb. (1917) 214; HEYNE, Nutt. Pl. (1927) 607; BACKER, Onkr. Suiker. (1930) 226, atl. t. 236.—*Achyranthes sanguinolenta* LINNÉ, Sp.Pl. ed. 2 (1762) 294; BURM. f. Fl. Ind. (1768) 63.—*Achyranthes scandens* ROXB. Fl. Ind. 2 (1824) 509.—*Aerva scandens* WALL. Cat. (1829) 6911, *nomen*; MOQ. l.c. 302; MIQ. l.c. 1039; HOOK. f. Fl. Br. Ind. 4 (1884) 727; KOORD. l.c. 198; MERR. En. Philip. Fl.Pl. 2 (1923) 130; GAGN. in Fl. Gén. I.C. 4 (1936) 1034.—*Aerva timorensis* MOQ. l.c. 301; MIQ. l.c. 1039.

Perennial herb, often more or less woody at base,  $3/4-2$  m high, erect or  $\pm$  clambering, branched or not; stem terete, its upper part densely clothed with appressed or patent soft white hairs, gradually glabrescent downward; internodes often longer than 3 cm. *Leaves* opposite or alternate (often on a single specimen), ovate-elliptic, oblong or lanceolate from a cuneate or contracted base, usually acute, mucronate, on both surfaces (especially so beneath) rather densely clothed with appressed white hairs, more or less tinged with purple (type) or green, 15-75 by 6-45 mm; petiole 3-10 mm. *Spikes* solitary or fascicled, partly in axils of ordinary leaves, partly in those of bracts and then often collected into a lax terminal spike or raceme with a well-developed terminal spike, cylindric, usually with a conical apex,  $3/4-5$  cm long, more or less tinged with purple or sordidly white, rarely pure white. *Flowers* softly membranous, (♂) (♀); bracts and bracteoles ovate, mucronate, externally pilose but not very densely so, rarely glabrous, acute  $1-1\frac{1}{2}$  mm long. *Tepals* oblong, acute, externally pilose but not very densely so,  $2-2\frac{1}{2}$  mm long; 2 outer ones minutely mucronate. *Stamens* slightly more than half as long as perianth. Style totalling  $\pm 1/2$  mm; stigma entire or very slightly 2-lobed with rounded lobes. Fruiting spike very dense and rather thick, not easily



Fig. 5. *Aerva lanata* (L.) JUSS. from Java,  $\times 1/5$ .

breaking up. *Utricle* fully 1 mm diam. Seed  $\frac{3}{4}$ –1 mm diam., shining brownish black.

Distr. India to China, in *Malaysia*: Java (incl. Madura & Kangean), Celebes (incl. Saleier & Muna), Philippines, Moluccas, (Ambon, Tanimbar), Lesser Sunda Isl. (Lombok, Sumbawa, Flores, Timor).

Ecol. Especially in periodically dry areas, in Java 5–200 m, in sunny or moderately shaded dry localities, brushwood, hedges, neglected premises, locally often numerous. The purple-tinged typical form is sometimes cultivated for medicinal purpose.

Uses. The red-leaved form used internally against haematuria and irregular or painful menstruation (doctrine of the signature).

Vern. *Ki sambang*, *sambang tjalak*.

Notes. In the Kew-herbarium I found 2 abnormal specimens collected in 1884 by J. G. FR. RIEDEL in Timor Laut (= Tanimbar Archipelago; 131°–132° E, 7°–8° S), where also normal plants have been gathered. These abnormal specimens had paniculate short spikes of deformed hairy flowers; most of these were asexual and consisted of insufficiently differentiated bracts, bracteoles and tepals. But several flowers were pseudo-bisexual; stamens 5, at the base connate in a short cup; filaments alternating with short subulate pseudo-staminodes; anthers 2-celled (4-locellate); ovary much compressed, glabrous, empty; stigma capitate, entire. Leaves on both surfaces pubescent; inflorescence pubescent. They had been reported to represent *Nothosaerva brachiata* by HEMSLEY (Rep. Bot. Chall. Exp. 1, 3 (1884) 183).

3. *Aerva curtisii* OLIV. in HOOK. f. Ic. Pl. 23 (1892), t. 2201; RIDL. Fl. Mal. Pen. 3 (1924) 8; BURK. & HEND. in Gard. Bull. 3 (1925) 409.

Straggling herb, sometimes slightly woody at base, 30 cm of usually much more; stem rather robust, rather thinly pilose. *Leaves* opposite, oblong-lanceolate or lanceolate from a gradually narrowed acute base, very acute, herbaceous, on both sides (especially beneath) thinly clothed with patent, rather long thin hairs, 5–15 by 2–4 cm; petiole  $\frac{3}{4}$ –2 cm. *Spikes* terminal or in higher forks of stem, racemed, umbellate or subpaniculate on a 1–2½ cm common peduncle, erect or patent, 1–4½ cm long, much less dense than in the 2 other Malaysian species; rachis rather thinly clothed with patent short hairs; bract-bearing rachis thin, not breaking up after fall of flowers or fruits. *Flowers* 3-farious or in the higher part of the spike bifarious, ♂, bracts persistent after the fall of flowers, patent, ovate, acuminate, acute, glabrous, very concave, 1-nerved, thinly membranous,  $\pm 1\frac{1}{2}$  mm long; bracteoles falling off together with the perianth, ovate, acute, very thin, nerveless,  $\pm 1$  mm. *Tepals* oblong, acute, rather firm, strongly 3–5-nerved, externally thinly clothed with very short hairs,  $\pm 3$  mm long. Free parts of filaments subulate from a broad base. Style  $\pm \frac{1}{2}$  mm; stigma subcapitate, entire. *Utricles* obovoid-oblong.

Distr. *Malaysia*: Malay Peninsula (Perak).

Ecol. On rocks in forests, 150–1000 m, fr. May.

Notes. This species is distinctly allied to some continental SE. Asiatic species, e.g. *Aerva cochinchinensis* GAGN.

## 9. NOTHOSAERVA

WIGHT, Icon. 6 (1853) 1.

Erect annual herb. *Leaves* opposite. *Flowers* in axillary, solitary or usually clustered, very dense, short spikes, minute, 3–5-merous, ♀; flowers solitary in the axil of a bract, subtended by 2 bracteoles; bracts and bracteoles minute, very thin, hyaline, persistent till after fall of fruiting perianth; rachis of spike not breaking up after fruiting. *Tepals* free acute, hyaline, 1-nerved, outside villous. Stamens 1–2, minute, free; no pseudo-staminodes; anthers 2-celled (4-locellate). Ovary oblong, compressed, glabrous; ovule 1, pendulous from the apex of a long funicle; style very short, stigma capitate, entire. *Utricle* compressed, thin-walled, indehiscent. Seed lenticular.

Distr. Monotypic, distributed through tropical Africa, Mascarenes & Comores to tropical Asia, and possibly *Malaysia*.

1. *Nothosaerva brachiata* (L.) WIGHT, Icon. 6 (1853) 1; HOOK. f. Fl. Br. Ind. 4 (1885) 726; HUB. WINKL. in Bot. Jahrb. 49 (1913) 366; MERR. En. Born. (1921) 246.—*Illecebrum brachiatum* LINNÉ, Mant. (1767) 23.—*Aerva brachiata* MART. Beitr. Amar. (1825) 83, no 3; MOQ. in DC. Prod. 13, 2 (1849) 304; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1040.

Stem usually much branched, often so from near the base, 0.10–0.60, glabrous. *Leaves* elliptic or ovate-elliptic from an acute base, obtuse or acute, minutely mucronate, thinly herbaceous, green, quite glabrous, 2–5 by  $\frac{1}{2}$ –2 cm; petiole 4–8 mm. *Spikes* very numerous, for the greater part in

clusters of 3–8, rarely solitary or paired, erect or patent, sessile or shortly stalked,  $\frac{1}{2}$ –1½ cm long, cylindric with rounded apex, white; bracts and bracteoles glabrous, in *sicco* white, patent; bracts ovate acute,  $\pm 1$  mm long; bracteoles slightly smaller. *Tepals*  $\pm 1\frac{1}{4}$  mm long, oblong, acute, nerveless, bluish red (*ex* WINKLER; in the specimens seen by me in *sicco* white), patently villous outside. Stamens 1–2; filaments very thin, anthers minute, style hardly perceptible. *Utricle* falling off with the enclosing perianth. Seed shining, brownish black,  $\pm \frac{3}{4}$  mm diam.

Distr. Trop. Africa & Mascarenes to SE. Asia,

in *Malaysia*: SE. Borneo (between Kuma and Sallinahu, fls bluish rosa, HUB. WINKLER 2950, fl. July).

Notes. I have not seen WINKLER's number which is the sole record in *Malaysia*. Neither have I seen a specimen with hairy stems or leaves. This species is sometimes confused with *Aerva lanata* (L.) JUSS. which may be easily distinguished by the

distinct hairiness of the stem and leaves and the manifestly bifid, longer style.

The specimens cited by HEMSLEY (Rep. Bot. Chall. 1, 3 (1884) 183) are abnormal plants and have proved to belong to *Aerva sanguinolenta* (L.) BL.

### 10. CENTROSTACHYS

WALL. in ROXB. Fl. Ind. 2 (1824) 497.

Aquatic herb. *Leaves* opposite, petioled, entire, herbaceous. *Flowers* ♂, spicate; spikes terminal, erect many-flowered, at last elongate; only few flowers open at the same time. Flowers solitary in the axil of a thin bract, subtended by 2 membranous bracteoles, after anthesis deflexed. *Tepals* 5, spreading during anthesis; before and after anthesis erect, firmly membranous, after anthesis hardened at base; outermost one rigid, pungent, 1-nerved; others distinctly shorter, plurinerved. Stamens 5, much shorter than perianth, at the base connate in a short cup, alternating with short, cuneate pseudo-staminodes; these dorsally, just below the truncate or subdentate top, with a fimbriate scale much surpassing them. Anthers oblong, 2-celled (4-locellate). Ovary glabrous; ovule 1, pendent from a long funicle; style filiform, short, persistent; stigma capitate. *Utricle* ovoid, thin-walled, indehiscent; seed erect.

Distr. Monotypic, from trop. Africa to SE. Asia, Java and Norfolk Island ( $\pm 168^\circ$  E,  $29^\circ$  S).

1. *Centrostachys aquatica* (R.Br.) WALL. Cat. (1829) 6932, *nomen*; MOQ. in DC. Prod. XIII, 2 (1849) 321; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1043.—*Achyranthes aquatica* R.Br. Prod. (1810) 417; ROXB. Fl. Ind. ed. CAREY (1832) 673; HOOK. f. Fl. Br. Ind. 4 (1885) 730; KOORD. Exk. Fl. 2 (1912) 149; GAGN. in Fl. Gén. I. C. 4 (1936) 1073.

Stem floating or ascending, rooting, terete, thick, striate-ribbed, densely appressed pubescent, medullate, 0.75–1.50 m long. *Leaves* oblong-lanceolate from an acute base, acuminate, acute,  $7\frac{1}{2}$ –15 by 2–3 cm, on both surfaces clothed with appressed long, white hairs; indumentum of young leaves very dense, growing thinner with age; petiole 1–3 cm. *Spikes* erect,  $7\frac{1}{2}$ –45 cm; rachis rather densely appressed pilose; bracts, bracteoles and flow-

ers glabrous; flowers at first crowded, afterwards remote; bracts soon reflexed, ovate, acuminate, 3–4 mm; bracteoles embracing together the foot of the perianth, broadly ovate-orbicular, very concave, 3–3½ mm diam. Outermost tepal with very narrow transparent margins and a firm, slightly recurved, subulate tip, 6–8 mm long; other ones with broader transparent margin 5–7 mm long. Filaments (staminal cup included) 2–3 mm long; anthers  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm. Style  $1\frac{3}{4}$ – $2\frac{1}{2}$  mm. *Utricle* (not seen) rather acute,  $\pm 4$  mm long.

Distr. Trop. Africa to SE. Asia, in *Malaysia*: E. & Central Java.

Ecol. In Central Java at 450, in E. Java at 20 m, in swampy or inundated localities, locally abundant but, on the whole, very rare.

### 11. ACHYRANTHES

LINNÉ, Sp.Pl. 1 (1753) 20.

Erect or ascending terrestrial herbs. *Leaves* opposite, petioled, entire, herbaceous. *Flowers* ♂ spicate. Spikes terminal or axillary, erect, many-flowered, at last elongate; only few flowers open at the same time; flowers solitary in the axil of an acuminate, acute, membranous, persistent bract, subtended by 2 bracteoles, after anthesis deflexed; bracteoles consisting of a rather long spine bearing on either side of its thick concave base a much shorter, membranous nerveless wing. *Tepals* 5, spreading during anthesis, before and after anthesis erect, membranous or herbaceous-coriaceous, 1- or more-nerved, very acute, in fruit pungent or not. Stamens 5, much shorter than the perianth; filaments at the base connate in a short cup, alternating with short broad pseudo-staminodes; anthers oblong, 2-celled (4-locellate). Ovary glabrous; ovule 1, pendent from a long funicle; style filiform, short, persistent; stigma capitate. *Utricle* falling off together with perianth and bracteoles,



by means of bracteoles or tepals easily adhering to passers-by, ellipsoid with truncate or depressed apex, thin-walled, indehiscent. Seed erect.

Distr. Few spp., mostly in the Old World, often introduced.

Notes. In Malaysia transitions between the 2 species described below have not yet been found.

#### KEY TO THE SPECIES

1. Back of the pseudo-staminodes just below the apex with a long-fringed scale much surpassing the pseudo-staminode itself. Basal wings of the bracteoles (when not damaged) adnate throughout their length to the spine,  $1\frac{1}{4}$ –2 mm long . . . . . **1. A. aspera**
1. Back of the pseudostaminodes without a scale. Basal wings of the bracteoles inserted on the thick base of the spine, otherwise free from it,  $\frac{1}{2}$ – $1\frac{1}{4}$  mm long . . . . . **2. A. bidentata**

**1. *Achyranthes aspera* LINNÉ**, Sp.Pl. (1753) 204; BLANCO, Fl. Filip. (1837) 188, ed. 2 (1845) 133; ed. 3, 1 (1877) 239; MOQ. in DC. Prod. 13, 2 (1849) 314; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1042; Suppl. (1860) 365; BTH. Fl. Austr. 5 (1870) 240; HOOK. f. Fl.Br. Ind. 4 (1885) 730; BOERL. Ned. Kruid. Arch. II, 5 (1891) 421; KOORD. Minah. (1898) 563; BAILEY, Queensl. Fl. pt 4 (1901) 231; KOORD. Exk. Fl. 2 (1912) 199; MERR. Interpr. Herb. Amb. (1917) 214; EN. BORN. (1921) 246; EN. PHILIP. Fl.Pl. 2 (1923) 31; DOMIN, Beitr. Pflanzengeogr. Austr. (1929) 638; RIDL. Fl. Mal. Pen. 3 (1924) 8; HEYNE, Nutt. Pl. (1927) 607; BACKER, Onkr. Suiker. (1930) 228, Atl. t. 238; OCHSE & BAKH. V. D. Br. Veget. (1931) 40, fig. 7; GAGN. in Fl. I.C. 4. (1936) 1071.—*Achyranthes canescens* R.Br. Prod. (1810) 417; MOQ. L.c. 315; HASSK. Pl. Jav. Rar. (1848) 412.—*Achyranthes argentea* DECNE in Nouv. Ann. Mus. 3 (1834) 372; SPAN. in Linnaea 15 (1841) 345.—*Achyranthes grandifolia* MOQ. L.c. 313; MIQ. L.c. 1042.

Erect rather stiff herb  $\frac{1}{4}$ – $1\frac{1}{4}$  m high, usually branched from near the base; branches obliquely erect or ascending; stem angular-ribbed, thickened above the nodes, hard, more or less densely hairy. Leaves oval-obovate or elliptic-oblong, from an acute or obtuse base, acuminate or not, acute, obtuse or rounded, entire, flat or more or less wavy, more or less densely hairy or, barring the nerves, glabrous or subglabrous,  $1\frac{1}{2}$ –10 cm by  $\frac{3}{4}$ – $5\frac{1}{4}$  cm; petiole  $\frac{1}{2}$ – $1\frac{1}{2}$  cm. Spikes terminal, erect, 10–75 ( $\frac{1}{2}$ –15 cm peduncle included); rachis rather robust, stiff, angular-ribbed, more or less densely clothed with appressed or more or less patent, rather long white hairs; bracts long-acuminate, not pungent, 2– $3\frac{1}{2}$  mm long, before anthesis erect, afterwards spreading, at last quite reflexed as often is the fruiting perianth also,  $\pm$  silvery; bracteoles appressed against base of perianth. Spines  $2\frac{3}{4}$ – $4\frac{1}{2}$  mm, shining, often tinged with purple, sharp; basal wings almost throughout their length adnate to spine but most easily separating from it,  $1\frac{1}{4}$ –2 mm long. Tepals ovate-lanceolate, very acute, green with pale margins, with 3 or more rather strong nerves, during anthesis  $3\frac{1}{2}$ – $5\frac{1}{2}$  mm long, afterwards up to  $4\frac{1}{2}$ – $6\frac{1}{2}$  mm, hardening and becoming pungent. Filaments (staminal cup included)  $2\frac{1}{4}$ – $3\frac{1}{2}$  mm; pseudo-staminodes truncate or crenulate, just below the apex with a dorsal long-fringed scale far exceeding the top of the pseudo-staminode itself; ovary turbinate; style 1–2 mm. Utricle rounded at the base,  $2\frac{1}{2}$ – $2\frac{3}{4}$  mm long.

Distr. Ubiquist, in Malaysia: throughout the

Archipelago, possibly not truly indigenous in Malaysia.

Ecol. Sunny dry localities especially in regions with a well-marked dry monsoon: road-sides, waste places, a typical ruderal, 1–2300 m.

Uses. Rubbed on the body of young children against convulsions.

Vern. *Djarong*, *njarong*, etc.

Notes. In Journ. Ind. Bot. Soc. 11 (1932) 335

A. C. JOSHI describes and figures a case of dedoublement of stamens in this species.

**2. *Achyranthes bidentata* BL. Bijdr.** (1825) 545; MOQ. in DC. Prod. 13, 2 (1849) 312; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1040; BOERL. in Ned. Kruid. Arch. II, 5 (1891) 427; KOORD. Minah. (1898) 564; SCHUM. & LAUT. Fl. Deut. Sch. Geb. (1901) 306; KOORD. Exk. Fl. 2 (1912) 199; PULLE in Nova Guinea 8 (1912) 627; MERR. En. Philip. Fl.Pl. 2 (1923) 545; HEYNE, Nutt. Pl. (1927) 607; GAGN. in Fl. Gén. I.C. 4 (1936) 1072.—*Achyranthes javanica* MOQ. L.c. 312; MIQ. L.c. 1041.

Erect or ascending, rather flaccid herb,  $\frac{3}{4}$ – $1\frac{1}{2}$  m long; stem  $\pm$  quadrangular with longitudinally furrowed sides, often purple in higher part, thinly or moderately densely clothed with appressed or patent long, fine, white hairs. Leaves elliptic-oblong-lanceolate or ovate-lanceolate from an acute or obtuse base, long acuminate, on both surfaces thinly or moderately densely clothed with appressed or patent longish hairs, 5–20 by 1–8 cm; petiole  $\frac{1}{2}$ – $3\frac{1}{2}$  cm. Spikes terminal and in the higher leaf axils, 4–45 cm long (including 1–15 cm peduncle); rachis rather thin and flaccid, often somewhat tortuous, rather densely clothed with appressed of more or less patent long white hairs; bracts long-acuminate, not pungent, 3– $3\frac{1}{2}$  mm long, before anthesis erect, afterwards patent or reflexed; bracteoles appressed against base of perianth, often slightly recurved at the apex, very variable in length,  $2\frac{1}{2}$ – $5\frac{1}{2}$  mm, basal wings inserted on the thick base of a spine, otherwise free, erect or more or less patent,  $\frac{1}{2}$ – $1\frac{1}{4}$  mm long. Tepals (midrib excepted) thinly membranous and nerveless, very acute, during anthesis often violet, often distinctly unequal, variable as to length,  $4\frac{1}{2}$ –7 mm, not becoming pungent. Filaments (staminal cup included) 2– $2\frac{1}{2}$  mm long; pseudo-staminodes truncate, entire or mostly irregularly dentate, without dorsal scale. Style  $\frac{1}{2}$ –2 mm. Utricle subtruncate, 2– $2\frac{1}{2}$  mm long.

Distr. Tropical Africa and Asia, in Malaysia:

Sumatra, Java, Celebes, Philippines, Moluccas, Lombok and New Guinea.

Ecol. Throughout Java, 350–2500 m, in forests and well-shaded localities, often abundant along trails under everwet conditions.

Uses. Internally used as an anthelmintic; masti-

cated against malignant ulcers of the cavity of the mouth.

Notes. It is remarkable that this species has not yet been collected in the Mal. Peninsula, Borneo and most of the Lesser Sunda Islands. Unlike *A. aspera* it is certainly indigenous in Malaysia.

#### Excluded

*Achyranthes linearifolia* Sw. in WIKSTRÖM, Vet. Akad. Handl. Stockholm för 1825 (1826) 428 (not: 48) is quoted by Ind. Kew. as described from the Moluccas. It came from St Barthélemy, E of Porto Rico, in the West Indies, as I was kindly informed by Dr FLORIN.

*Achyranthes spiciflora* BURM. f. Ind. Alt. Herb. Amb. (1769) 5, non *ibid.* 203; PENNANT, Outl. of

the Globe 4 (1800) 257 is based on *Cauda felis agrestis* RUMPH. Herb. Amb. 4, p. 84. According to MERRILL (J. Arn. Arb. 29 (1948) 188) this is *Acalypha amentacea* ROXB. (Euph.).

*Achyranthes hispida* PENNANT, l.c. is according to MERRILL, l.c., *Acalypha hispida* BURM. f. Fl. Ind. (1768) 303, pl. 61, f. 1 (Euph.).

### 12. PTILOTUS

R.BR. Prod. (1810) 415.

Annual herbs. *Leaves* alternate, entire, often narrow. *Flowers* ♂, terminal, in globular conical or cylindrical dense heads or short spikes, solitary in the axil of a bract, subtended by 2 bracteoles; bracts and bracteoles scarious; *tepals* free or at the base shortly connate, usually dimorphous, after anthesis indurated at the base or not, glabrous or clothed on the back with denticulate, often long hairs, inside glabrous or woolly. Stamens 5; filaments free or connate in short cup, with or without interposed, small, translucent pseudo-staminodes, all perfect or 1–2 sterile. Anthers 2-celled (4-locellate). Ovary sessile or shortly stalked, glabrous or hairy; ovule 1, pendent from basal erect long funicle; style central or slightly excentric, long, thin; stigma capitate. *Utricle* enclosed by perianth, indehiscent. Seed vertical, sometimes arillate.

Distr. If united with *Trichinium*, which is now almost universally done, this large genus is practically confined to Australia and Tasmania, in *Malaysia*: one Australian species.

Ecol. Mainly confined to semi-arid regions.

**1. *Ptilotus conicus*** R.BR. Prod. (1810) 415; MOQ. in DC. Prod. 13, 2 (1849) 282; BTH. Fl. Austr. 5 (1870) 242; BAILEY, Queensl. Fl. pt 4 (1901) 1222.—*Ptilotus corymbosus* (non R.BR.), BLUME, Bijdr. (1825) 543; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1036.—*Ptilotus amabilis* SPAN. in Linnaea 15 (1841) 345, *ic. ined.* 59 in *Herb. Lugd. Bat.*—*Ptilotus conicus* var. *timorensis* ENGL. Bot. Jahrb. 7 (1885) 454.

Stem erect, 40–60 cm high, slender, glabrous, often already quite near the base divided into ascending main-branches, in higher part with erecto-patent branchlets. *Leaves* rather distant, narrowly linear, acute, with (*in sicco*) recurved margins, glabrous, 2–5 cm by  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm. *Heads* in higher portion of plant loosely panicleate-corymbose, at first globular,  $\pm \frac{3}{4}$  cm diam., growing more cylindrical with age, finally up to  $1\frac{1}{2}$  cm long; bracts and bracteoles with short acicular tips, 1-nerved,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long, persistent after the fall of perianth; flower-axis articulated above the bracteoles. *Tepals* shortly united at the base, purple,  $\pm \frac{4}{2}$  mm long; 2 outer ones elliptic,

outside at base with dense tuft of erecto-patent long hairs, otherwise glabrous,  $3$ – $3\frac{1}{2}$  mm long; 3 inner ones with an erect, narrowly cuneate, 3-nerved claw and a slightly longer and (at the base) broader, ovate-oblong, 1-nerved, patent blade; claw along either margin densely clothed with intricate, long, thin, dentate hairs. Perfect stamens 5, glabrous,  $\pm \frac{4}{2}$  mm, filaments narrowly ligular, at base connate into a short cup; free parts tapering upwards but at  $\frac{3}{4}$ –1 mm below top abruptly broadened into a subcircular disk, above this dilatation much contracted, filiform; anthers short; no pseudo-staminodes. Style glabrous,  $\pm \frac{2}{2}$  mm. *Utricle* narrowly ovate compressed,  $\pm \frac{2}{2}$  mm.

Distr. N. Australia (Gulf of Carpentaria), in *Malaysia*: Lesser Sunda Islands (Flores, Roti, Timor, Wetar), and S. Moluccas (Tanimbar, Key); a distinct Australian element in the Malaysian flora.

Ecol. Apparently confined to open country in periodically dry regions, at low alt., in Timor on calcareous hills.

### 13. PSILOTRICHUM

BLUME, Bijdr. (1825) 544.

Dwarf shrubs or herbs. *Leaves* opposite, entire. *Flowers* ♂, in terminal or axillary

heads or narrow spikes, solitary in the axil of a bract, subtended by 2 bracteoles. *Tepals* 5, free, narrow, strongly longitudinally plurinerved, membranous, after anthesis indurate or not. Stamens 5, filaments  $\pm$  unequal, at the base connate in a short cup; anthers small, 2-celled (4-locellate); no pseudo-staminodes. Ovary ellipsoid or globose; ovule 1, pendulous from a long erect funicle; style thin; stigma capitate. *Fruit* enclosed by the perianth, thin-walled, indehiscent; seed erect, lenticular.

Distr. About 14 spp. in Africa, SE. Asia and Malaysia, centering in Africa.

**1. *Psilotrichum ferrugineum* (ROXB.) MOQ. in DC. Prod. 13, 2 (1849) 279; HOOK. f. Fl. Br. Ind. 4 (1885) 725.**—*Achyranthes ferruginea* ROXB. Fl. Ind. ed. WALL. 2 (1824) 502.—*Psilotrichum trichotomum* BLUME, Bijdr. (1825) 545; MOR. Syst. Verz. (1845/6) 73; HASSK. Pl. Jav. Rar. (1848) 419; MOQ. l.c. 280; HASSK. in Pl. Jungh. (1852) 130 (*sphalm. tricholonum*); ZOLL. Syst. Verz. (1854) 109; HOOK. f. Fl. Br. Ind. 4 (1885) 725; KOORD. Ekk. Fl. 2 (1912) 199; MERR. En. Born. (1921) 246; EN. Philip. 2 (1923) 131; RIDL. Fl. Mal. Pen. 3 (1924) 8; BACKER, Onkr. Suiker. (1930) 227, Atl. t. 237; GAGN. in Fl. Gén. I.C. 4 (1936) 1066.—*Leiospermum ferrugineum* WIGHT, Ic. (1843) 721.—*Ptilotus trichotomus* MIQ. Fl. Ind. Bat. 1, 1 (1858) 1037.—Fig. 6.

Annual, erect or ascending, often much branched from near the base, 5–50 cm long, in sunny localities often strongly tinged with purple; stems thin, in the leaf axils and on the young nodes often  $\pm$  hairy, otherwise glabrous; pairs of leaves often distant. *Leaves* patent, variable in shape, lanceolate, oblong, elliptic or obovate, minutely mucronate, rather fleshy in a living state, glabrous,  $3/4$ – $7\frac{1}{2}$  by  $1\frac{1}{2}$ –2 cm; petiole 3–10 mm. *Spikes* usually terminal or in forkings of stem, sometimes also axillary, solitary or rarely paired, sessile or on thin and often rather long peduncles, at first shortly conical, afterwards lengthened, rather acute, dense, 1– $2\frac{1}{2}$  cm long; rachis pilose; lowest fruits often falling off before expansion of the highest flowers; bracts and bracteoles thinly membranous; bracts widely patent or subreflexed, ovate-lanceolate, concave, very acute,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long, persistent; bracteoles ovate-triangular, nerveless,  $1/2$ – $3/4$  mm long, falling off together with the perianth and the fruit. *Perianth* much longer than the bract and the bracteoles. *Tepals* lanceolate, very acute, throughout their width with 3–5 strong longitudinal nerves, glabrous, 2– $2\frac{1}{2}$  mm long, not or hardly indurate after anthesis. Filaments very thin,  $1/2$ – $3/4$  mm long (cup included). Style  $1/2$ – $2/5$  mm, persistent. *Utricle* ellipsoid, compressed-pellucid but opaque at the apex, 1– $1\frac{1}{2}$  mm long. Seed vertical, shining black or blackish brown,  $\pm$  1 mm long or slightly longer.

Distr. SE. Asia, in *Malaysia*: throughout the Archipelago, not yet reported from the Lesser Sunda Islands and the Moluccas.

Ecol. Humid clayey fields, along ditches and trenches, locally often numerous, 5–1200 m, on the whole not a very common species.

Notes. The shape of the leaves is very variable.



Fig. 6. *Psilotrichum ferrugineum* (ROXB.) MOQ. from Java,  $\times 1/3$ .

## 14. ALTERNANTHERA

FORSK. Fl. Aeg.-Arab. (1775) 28.

Annual or perennial, erect, ascending, trailing, creeping, floating or clambering herbs, often hairy; hairs dentate or smooth. *Leaves* opposite, entire. *Flowers* ♀ or by malformation ♀, in axillary or rarely terminal, sessile or peduncled heads or short spikes, solitary in axil of bract, subtended by 2 bracteoles; bracts and bracteoles scarious. *Perianth* often dorsally compressed. *Tepals* 5, free, equal or unequal, glabrous or hairy. Stamens normally 2-5, sometimes partly anantherous; filaments at the base united in a tube or a short cup; free part short, usually alternating with (sometimes very minute) pseudo-staminodes; anthers small, 1-celled (2-locellate); pseudo-staminodes entire, dentate or laciniate. Ovary compressed or not; ovule 1, pendulous from a long funicle; style short; stigma capitate. *Utricle* indehiscent, sometimes corky, falling off with the perianth and with or without the bracteoles. Seed vertical.

Distr. Large genus, centering in America, some species in other parts of the World, in *Malaysia*: 6 species, of which 1 indigenous (one variety endemic); the 5 others introduced from trop. America. Three of these are naturalized and, often on a large scale, locally firmly established. The other two are cultivated.

Uses. The gregarious matted growth of some species is sometimes used for protecting soils from rain-wash. Others are cultivated for ornamental purposes.

Notes. In some species the hairs are, under the microscope, smooth, in others they are minutely but distinctly dentate. This neglected character is of importance for specific delimitation; it proved constant in the Malaysian species treated here.

## KEY TO THE SPECIES

1. Heads all sessile (after the fall of the lower flowers often *seemingly* stalked, but in this case the spurious peduncle is at once recognized as the rachis of the head by the presence of bracts). Perianth sessile between the bracteoles. Filaments at the base united in a *very short* cup.
  2. Bracts and tepals not spinescent.
    3. All tepals 1-nerved, or only at the very base obscurely 3-nerved, not with indurate bases. Bracts not or shortly acuminate. Anthers 3, oval or oblong. Pseudo-staminodes minute, entire, perhaps sometimes wanting. Leaves green. *Hairs smooth*.
      4. Leaves variable as to shape but *not* narrowly linear-filiform,  $\frac{3}{4}$ -15 by  $\frac{1}{4}$ -3 cm . . . 2. *A. sessilis*
      4. Leaves *very* narrowly linear-filiform, 2-6 cm by  $\frac{1}{2}$ -2 mm . . . 2. *A. sessilis* var. *tenuissima*
    3. Three outer tepals in their lower  $\frac{1}{3}$ - $\frac{1}{2}$  distinctly 3-nerved, their bases at last indurate. Bracts rather long-acuminate. Anthers 5, linear, 1-2 of them sometimes shorter than the others. Leaves often coloured. *Hairs dentate* . . . 3. *A. ficoides*
  2. Bracts and 2 outer tepals with *spinescent* tips. Entire head conspicuously prickly. Stems trailing or creeping. *Hairs dentate* . . . 1. *A. repens*
1. Heads usually borne on a distinct bractless peduncle (if sessile then the perianth is 5-7 mm long!). Filaments united at the base into a *distinct tube*. Pseudo-staminodes distinct, divided into narrow apical straps.
  5. Stems solid, their young parts hairy all round; hairs minutely dentate. Bracts, bracteoles and perianth hairy. Leaves, when not too old, densely appressed-hairy all over the lower surface. Not aquatic.
    6. Perianth yellowish-white, placed between the bracteoles on a short but distinct stalk, falling off together with this stalk. Top of the bracteoles with a distinct dorsal hairy crest. Bracts with a rather long mucro. Robust plant . . . 5. *A. brasiliana*
    6. Perianth red, sessile between the bracteoles. Bracteoles not crested. Bracts with a very short mucro or without one . . . 6. *A. porrigens*
  5. Stems in their lower part fistulose. Leaf axils with white smooth hairs, on two opposite sides with a longitudinal hairy groove, otherwise glabrous. Plant of very humid localities, often growing in shallow water . . . 4. *A. philoxeroides*

1. *Alternanthera repens* (L.) STEUD. Nomencl. ed. 2, 1 (1840) 65; O.K. Rev. Gen. 2 (1891) 540; ASCH. & GR. Syn. 5, 1 (1914) 362; BACKER, Onkr. Suiker. (1930) 229, atl. t. 239.—*Achyranthes repens* LINNÉ, Sp.Pl. (1753) 205.—*Illecebrum achyrantha* LINNÉ, Sp.Pl. ed. 2 (1762) 299.—*Alternanthera achyrantha* R.BR. Prod. (1810) 417; MOQ. in DC.

Prod. 13, 2 (1849) 358; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1049; BACKER, Bull. J.B.B. II, 12 (1913) 7.

Prostrate herb, often rooting; taproot robust; stem terete, hard, on the younger parts densely clothed with appressed, minutely dentate, white hairs, 10-50 cm long. *Leaves* elliptic-obovate, narrowed into the petiole, with an obtuse or rounded

top, on the upper surface glabrous or thinly appressed-pilose, on the lower surface glabrous or on the nerves appressed-pilose,  $1\frac{1}{4}$ – $4\frac{1}{2}$  by  $\frac{1}{3}$ – $2$  cm, in a single pair often of very unequal size; petiole 2–10 mm. Heads 1–3 in the leaf-axils, sessile, globose or oblong, white,  $\frac{1}{2}$ – $1\frac{1}{2}$  cm long; bracts spine-tipped,  $\pm 4$  mm (including spine); bracteoles acuminate, very acute but not spinous, 3–4 mm long. *Tepals* very unequal: 2 abaxial ones much larger than the others, convex, spine-tipped,  $\pm 5$  mm long, above base right and left with hair-tuft, in the lower half with 3 upwards confluent nerves, hardening after anthesis; adaxial tepal rather flat, oblong, dentate near tip, mucronate, not spiny, at base right and left with hair-tuft,  $\pm 3\frac{1}{2}$  mm long, two inner tepals much smaller than the others, their lower halves very concave, embracing the ovary and afterwards the fruit, on the middle of their back with a patent hair-tuft. Stamens 5, all perfect; filaments (basal cup included)  $\frac{1}{2}$ – $\frac{3}{4}$  mm; anthers oblong, minute; pseudo-staminodes much shorter than filaments, broad, entire, emarginate or irregularly dentate. Style very short. *Fruit* falling off with perianth and bracteoles, broadly oval, much compressed, truncate or retuse, brown  $\pm 1\frac{1}{2}$  mm long.

**Distr.** Native of trop. America, introduced in Java, collected there for the first time in 1912, now established in some waste places on and near the northern coast, at low altitude, locally abundant, but on the whole still rare.

**Notes.** The specimen mentioned by BURMAN f. in his Fl. Ind. (1768) 66 as *Illecebrum achyranthes*, and conserved at Geneva in Herb. DELESSERT, is *Alternanthera sessilis*.

**2. *Alternanthera sessilis* (L.) R.Br. ex R. & S. Syst. 5 (1819) 554; MOQ. in DC. Prod. 13, 2 (1849) 357; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1048; Hook. f. Fl. Br. Ind. 4 (1885) 731; O.K. Rev. Gen. 2 (1891) 540; KOORD. Exk. Fl. 2 (1912) 200; ASCH. & Gr. Syn. 5, 1 (1914) 361; MERR. Interpr. Herb. Amb. (1917) 215; En. Born. (1921) 246; En. Philip. 2 (1923) 132; RIDL. Fl. Mal. Pen. 3 (1924) 10; BACK. & SLOOT. Handb. Thee. (1924) 109, t. 109; HEYNE, Nutt. Pl. (1927) 608; BACKER, Onkr. Suiker. (1930) 230, Atl. t. 241; GAGN. in Fl. Gén. I.C. 4 (1936) 1077.—*Gomphrena sessilis* LINNÉ, Sp.Pl. (1753) 225.—*Illecebrum sessile* BURM. f. Fl. Ind. (1768) 166.—*Illecebrum indicum* HOUTT. Nat. Hist. 2, 7 (1777) 713, t. 43, f. 3.—*Alternanthera triandra* LAMK. Encycl. 1 (1783) 95; BURK. Dict. 1 (1935) 116.—*Alternanthera denticulata* R.Br. Prod. (1810) 417; BLUME, Bijdr. (1825) 546; MIQ. l.c. 1048; BTH. Fl. Austr. 5 (1870) 249; Hook. f. l.c. 731; BAILEY, Queensl. Fl. pt 4 (1901) 1233, DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 639.—*A. nodiflora* R.Br. Prod. (1810) 417; MIQ. l.c. 1047; BTH. l.c. 249; BAILEY, l.c. 1233; KOORD. Exk. Fl. 2 (1912) 200; DOMIN, l.c. 639.—*Achyranthes villosa* (non FORSK.) BLANCO, Fl. Filip. (1837) 189; ed. 2 (1845) 134; ed. 3, 1 (1877) 240.—*Adenogramma oppositifolia* HASSK. in Flora 31 (1851) 754.—**Fig. 7.****

Herb, perennial or under unfavourable circum-

stances short-lived, often pluricaulous, 10–100 cm long; taproot robust; stem either erect, ascending or creeping and solid, (or, in inundated localities, floating and in the lower part fistular), green or more or less tinged with purple, on 2 opposite sides with a longitudinal row of hairs, across the nodes



**Fig. 7. *Alternanthera sessilis* (L.) R.Br. from Java,  $\times 1/5$ .**

with a transverse row of hairs, otherwise glabrous; hairs articulate, smooth. *Leaves* variable as to shape and size, varying from linear-lanceolate via oblong to oval or obovate, acute at the base, acute, obtuse or rounded at the apex, green, glabrous or thinly and finely pilose,  $\frac{3}{4}$ – $1\frac{1}{2}$  cm by  $\frac{1}{4}$ – $\frac{3}{4}$  cm, in wet localities comparatively large, in dry localities much smaller; petiole 1–5 mm. *Heads* 1–4 in the axil of present or fallen leaves, sessile but by the fall of lower flowers often spuriously peduncled, at first globose, growing more cylindrical with age,  $\frac{1}{2}$ – $1\frac{1}{2}$  cm long; rachis densely white-hairy; bracts and bracteoles not or shortly acuminate, glabrous, white, persistent after the fall of the flowers; bracts  $\frac{2}{3}$ – $1$  mm; bracteoles  $1$ – $1\frac{1}{2}$  mm. *Tepals* shortly acuminate or not, glabrous or on the back with few or several hairs, white or purplish, shining (in a living state), 1-nerved or only at the very base obscurely 3-nerved, after anthesis not hardening in the lower part,  $2\frac{1}{2}$ – $3$  mm long. Filaments 5 of which only 3 antheriferous,  $\pm \frac{3}{4}$  mm long (basal cup included); anthers oval-oblong,  $\frac{1}{6}$ – $\frac{1}{4}$  mm; pseudo-staminodes subulate-filiform, entire, very minute, not exceeding filaments, often shorter. Style during anthesis very short, afterwards slightly

lengthened. *Fruit* falling off with the perianth, oboeniform, deeply emarginate, *corky*, dark brown, glabrous, 2-2 1/4 by 2 1/2-3 mm; lobes finally longer than the interspersed style.

*Distr.* Throughout the Old World, in *Malaysia*: throughout the Archipelago.

*Ecol.* A common plant, 1/2-1250 m, in constant or periodically humid or even inundated, open localities: fallow rice-fields, road-sides, gardens, shallow ditches, swamps, tea-plantations. Fruits often floating in great quantities upon the water.

*Uses.* An infusion of the entire plant is used as a remedy against intestinal cramps and as a cooling hair-wash.

*Vern.* *Daun tolod*, *M*, *kremak*, *J*.

*Notes.* The habit of the species varies exceedingly with the habitat.

*var. tenuissima* (SUESS.) *comb. nov.*—*Alternanthera tenuissima* SUESSENGUTH in Bot. Arch. 39 (1939) 382.

Leaves from a narrowed base very narrowly linear or almost filiform, acute, shortly mucronate, with a strongish midrib, when very young sparsely beset with longish white hairs, soon becoming glabrous, 2-6 cm by 1/2-2 mm. Pseudo-staminodes not found.

*Distr. Malaysia*: NE. New Guinea (Morobe distr., CLEMENS 6339).

*Ecol.* The only collection known was made in a garden, as a weed, at c. 1800 m alt.

*Notes.* In contrast to SUESSENGUTH who says that it is not closely allied to any Malaysian species, I find this aberrant form in all *essential* characters agreeing with *A. sessilis* from which it differs only by the peculiar shape and width of the leaves. It might be an etiolated or depauperated form.

A specimen closely resembling this variety was figured by DOMIN (*l.c.*) under the name of *A. nodiflora* R.Br. from Queensland.

**3. *Alternanthera ficoides* (L.) R.Br. ex R. & S.** Syst. 5 (1819) 555; MERR. En. Philip. Fl. Pl. 2 (1923) 131.—*Gomphrena ficoidea* LINNÉ, Sp. Pl. (1753) 235.—*Gomphrena polygonoides* LINNÉ, Sp. Pl. (1753) 225, *ex parte*.—*Alternanthera polygonoides* R.Br. Prod. (1810) 416; ASCH. & GR. 5, 1 (1914) 364.—*Telianthera manillensis* WALP. in Nov. Act. Ac. Nat. Cur. 19 (1843) Suppl. 1, 404.—*Telianthera polygonoides* Moq. in DC. Prod. 13, 2 (1849) 363.

*var. bettzickiana* (NICH.) *comb. nov.*—*Alternanthera bettzickiana* NICH. Gard. Dict. ed. 1 (1884) 59; ASCH. & GR. Syn. 5, 1 (1914) 365.—*Alternanthera amoena* (non VOSS.?) BACK. & SLOOT. Handb. Thee. (1924) 108, t. 108; HEYNE, Nutt. Pl. (1927) 608.

Perennial herb, 20-50 cm high; stem erect or at the base for a greater or smaller part decumbent and rooting, often much branched and forming dense tufts, terete in the lower part, quadrangular upwards, on 2 opposite sides with a longitudinal furrow, appressed-pilose at the top and on the nodes. *Leaves* oblong, oblong-obovate or spatulate from an acute base, acute or obtuse, finely mucronate, often  $\pm$  crisp, not rarely entirely

green, but mostly in different ways variegated with brownish red, bright red, pink or yellow, when young clothed with fine dentate hairs, glabrescent, 1-6 by 1/2-2 cm; petioles 1-4 cm,  $\pm$  hairy. *Heads* terminal and axillary, often in dense clusters of 2-5, globular or oblong, 1/2-1 cm long; hairs of bracts, bracteoles and floral parts, when present, minutely dentate; rachis hairy; bracts and bracteoles rather long-acuminate, very acute, glabrous or on the back with long hairs; bracts 1 3/4-3 mm; bracteoles 2-2 3/4 mm. *Perianth* often  $\pm$  dimorphed and then consisting of more than 5 tepals; normal tepals white or yellowish, shiny; 3 outer ones in their lower 1/3-1/2 with 3 close-set strong, upwards convergent nerves; their bases finally indurate; 2 abaxial tepals ovate-oblong, 3-4 mm long, concave, in their lower halves rather densely patently pilose on the back; their upper halves acutely acuminate, glabrous; adaxial tepal ovate-oblong, faintly concave or almost flat, sparingly hairy or glabrous, 2 3/4-3 1/2 mm long; 2 inmost tepals very concave, narrower and shorter than the others, sparingly hairy or glabrous. Stamens (basal cup included) 1 1/4-2 1/4 mm long; anthers 5, linear; 1-2 often somewhat shorter than the others and sterile; fertile ones 3/4-1 mm; pseudo-staminodes strap-shaped, reaching up to the middle or the top of the anthers, at the apex cleft into 3-5 very narrow strips. Ovary glabrous; style subconical rather thick  $\pm$  1/2 mm. *Utricle* in Java not developing (in typical *A. ficoides* faintly notched).

*Distr.* Native of Brazil, already long ago introduced into Java, in *Malaysia* (at least in Sumatra and Java) frequently cultivated as an ornamental plant, or in tea-plantations along the borders of terraces as a protector from rain-wash, for which purpose it is, by its densely tufted growth, eminently adapted, 1-2000 m.

*Ecol.* In *Malaysia* fruits are never produced.

*Uses.* See above.

*Vern.* *Djoekoet* sèlon (*Ceylon-grass*), *ketitjag abang*, *J*.

*Notes.* A form of *A. ficoides* with entire, subulate pseudo-staminodes and shorter petioles has been collected in Banka, probably also in a cultivated state: *var. versicolor* (REGEL) BACK.

**4. *Alternanthera philoxeroides* (MART.) GRISEB.** in GOETT. Abh. 24 (1879) 36; O.K. Rev. Gen. 2 (1891) 540; KOORD. Exk. Fl. 2 (1912) 200; BACKER, Onkr. Suiker. (1930) 230, Atl. t. 240; OCHSE & BAKH. V. D. Br. Veget. (1931) 15, f. 10.—*Bucholzia philoxeroides* MART. Beitr. Amar. (1825) 107.—*Telianthera philoxeroides* Moq. in DC. Prod. 13, 2 (1849) 362; BACKER in Ann. J.B.B. II, Suppl. 3 (1909) 417.

Perennial herb, ascending from a creeping or floating, rooting base, often much branched and forming dense masses, 1/2-1 m long; stem fistular, in the leaf-axils with a transverse row of white, smooth hairs, on 2 opposite sides with a longitudinal hairy groove. *Leaves* oblong or oblong-obovate from a tapering base, acute or rather obtuse, submucronate, glabrous or ciliate, 2 1/4-8 by 3/4-2 1/2 cm; petiole 3-6 mm. *Heads* terminal and ses-

sile, or usually axillary and then mostly peduncled, solitary, ovoid-globular-ellipsoid,  $3/4-1\frac{1}{2}$  cm long; peduncle usually  $1-4\frac{1}{2}$  cm, not rarely shorter, seldom almost wanting, on the adaxial side with a longitudinal hairy groove, otherwise glabrous; bracts and bracteoles 1-nerved, glabrous, white, persistent after fall of perianth; bracts ovate-triangular,  $2-2\frac{3}{4}$  mm; bracteoles ovate, acuminate, very acute,  $2\frac{1}{4}-2\frac{1}{2}$  mm. Perianth almost sessile above the bracteoles, dorsally compressed, shining white, glabrous,  $5-7$  mm long. *Tepals* oblong, acute or rather obtuse, 1-nerved. Stamens in normal flowers (see beneath) 5; filaments  $3\frac{1}{2}-4$  mm (including short staminal cup); anthers linear,  $1-1\frac{1}{4}$  mm; pseudo-staminodes about as long as stamens, oblong-linear; their tips divided into a few narrow strips. Ovary shortly stalked, broadly obovate-cuneate, dorsally compressed, rounded at the apex; style short, thick. *Fruit* in Malaysia never produced.

Distr. Native of Brazil, introduced long ago in Java, in *Malaysia* found for the first time in 1875 near Batavia by O. KUNTZE, at present quite naturalized in many localities in W. Java, not yet recorded from elsewhere in Malaysia.

Ecol. In stagnant or slow-moving shallow water, pools, ditches, often gregarious. In Malaysia fruits are unknown.

Notes. In Java the stamens are very often replaced by as many sterile spurious ovaries surrounding the true ovary. This malformation was pictured and described by COSTERUS in Ann. Jard. Bot. Botz 23 (1910) 12, t. III.

5. *Alternanthera brasiliana* (L.) O.K. Rev. Gen. 2 (1891) 537.—*Gomphrena brasiliana* LINNÉ, Amoen. 4 (1759) 310.—*Alternanthera strigosa* HASSK. in Tijdschr. Nat. Gesch. & Phys. 5 (1838/9) 259; in Flora (1842) II lit. p. 19; Plant. Jav. Rar. (1848) 420.—*Telanthera strigosa* MOQ. in DC. Prod. 13, 2 (1849) 370; KOORD. Exk. Fl. 2 (1912) 201.—*Mogiphanes jacquinii* (non SCHRAD.) BOERL. Hand. Genes- & Nat. Congr. Leiden (1889) 148.—*Telanthera praelonga* (an MOQ. ?) BACKER in Ann. J.B.B. Suppl. 3 (1909) 416.

Perennial herb, decumbent at the base, higher up ascending-erect or clambering among and over other plants, often widely branched,  $1\frac{1}{2}-3$  m high; all hairs minutely dentate; stem obtusangular or subterete, thickened and articulate above the nodes, on the younger parts densely clothed with appressed acroscopic long white hairs, gradually glabrescent. Pairs of *leaves* rather distant, blade ovate-lanceolate from a cuneate or contracted base, acuminate, acute, at first densely appressed pilose on both surfaces, slowly glabrescent,  $3\frac{1}{2}-10$  by  $3/4-4$  cm; petiole  $1/2-1\frac{1}{4}$  cm. *Heads* terminal, often in bifurcations of the stem, solitary or rarely 2-3 together, stalked, at first hemispheric-ovoid and 6-8 mm diam., afterwards increasing in size, ovoid-oblong, 12-16 by 10-12 mm; stalks at first short, lengthening with age, finally 6-16 cm, more or less densely clothed with appressed acroscopic long white hairs; rachis densely hairy; bracts and bracteoles long-ovate, acuminate, acute, yellowish

white, 1-nerved; bracts  $2\frac{1}{2}-3\frac{1}{4}$  mm, at first densely clothed with appressed long, white, for the greater part deciduous hairs; bracteoles considerably shorter than perianth,  $3-3\frac{1}{2}$  mm, on back long-hairy; persistent. *Perianth* distinctly stalked between bracteoles, falling off with the stalk; stalk  $1/2-3/4$  mm long, at base with a whorl of patent longish hairs, thick, with 5 longitudinal ribs; ribs strong, at the base thickened and shining (not glandular). *Tepals* oblong-lanceolate, acute, strongly 3-nerved, yellowish white, at first on back appressed long-hairy, gradually losing most hairs, 4-5 mm long. Filaments (staminal cup included)  $2-2\frac{1}{2}$  mm; anthers linear,  $1\frac{1}{3}-1\frac{1}{2}$  mm; pseudo-staminodes narrow, slightly longer than stamens, shortly dentate at apex. Ovary obovoid; style  $1\frac{1}{3}-1\frac{1}{2}$  mm. *Utricle* ellipsoid, its top on both sides of the style with an obtuse knob,  $\pm 2\frac{1}{4}$  mm long.

Distr. Native of trop. America, introduced into Java more than a century ago, in *Malaysia*: at present naturalized in a wide circle around Buitenzorg, and also collected in Central Java, as yet not found in other islands.

Ecol. Moist, shaded localities, 200-600 m, steep ravine slopes, stream banks, locally often gregarious.

6. *Alternanthera porrigens* (JACQ.) O.K. Rev. Gen. 2 (1891) 538; ASCH. & GR. Syn. 5, 1 (1914) 366.—*Achyranthes porrigens* JACQ. Hort. Schoenbr. 3 (1798) 54, t. 350.—*Telanthera porrigens* MOQ. in DC. Prod. 13, 2 (1849) 377.

Erect or ascending with erecto-patent branches,  $1/2-1\frac{1}{4}$  m high; all hairs minutely dentate; stems thin, firm; young parts densely clothed with appressed acroscopic rather long hairs. *Leaves* elliptic-oblong from an acute or contracted base, acute, mucronate,  $1\frac{1}{2}-6\frac{1}{4}$  by  $1/3-3\frac{1}{4}$  cm, at first on both surfaces densely clothed with appressed long hairs; hairs subsistent or those of upper surface gradually disappearing; petiole 2-10 mm. *Heads* terminal and near the tops of the branches also axillary, not very numerous, highest often in lax umbelliform inflorescences, often 2-3 together on a common peduncle and then 1-2 sessile; rest shortly peduncled; peduncle thin, firm, up to 10 cm long but often much shorter; axes of inflorescence and stalks of heads densely clothed with appressed acroscopic hairs; heads at first ovoid, afterwards more cylindrical, 6-15 by 4-6 mm; lowest flowers already fallen before expansion of highest; axis of head densely hairy; bracts acute or very shortly mucronate,  $\pm 2$  mm long, bracteoles very acute, densely hairy on back,  $\pm 2\frac{1}{4}$  mm. *Perianth* sessile between the bracteoles, red,  $3-3\frac{1}{2}$  mm long. *Tepals* oblong or ovate-oblong, 1-nerved, in lower half rather densely hairy on the back. Filaments (staminal cup included)  $1\frac{3}{4}-2$  mm; anthers linear,  $3/4-1$  mm; pseudo-staminodes strap-shaped, about as long as stamens, at top divided into a few narrow strips. Style  $1\frac{1}{4}-1\frac{1}{2}$  mm. *Fruit* broadly oblong, dorsally compressed,  $1-1\frac{1}{4}$  mm long.

Distr. A native of Peru, in *Malaysia*: once found in West Java as an introduced ornamental, and already met with as a garden-escape, probably not fit for naturalization.



15. GOMPHRENA

LINNÉ, Sp.Pl. 1 (1753) 224.

Annual, or less often perennial herbs. *Leaves* opposite, sessile or on short petioles. *Flowers* ♀, in terminal, solitary, sessile or subsessile heads or short spikes; receptacle cylindric or swollen. Flowers solitary in the axil of a persistent bract, subtended by 2 bracteoles; bracts and bracteoles scarious, glabrous; bracteoles erect, navicular, acute, often coloured, with or without dorsal crest, glabrous, falling off with perianth. Tepals 5, erect, free or nearly so, on back long-woolly. Stamens monadelphous; staminal tube long or short, shortly 5-lobed; free parts of filaments with or without intervening pseudo-staminodes, entire, retuse or distinctly 2-lobed; anthers introrse, 1-celled (2-locellate). Ovary compressed, glabrous; ovule pendulous from long erect funicle; style short or long; stigmas 2, erect or spreading, short, sometimes almost inconspicuous. *Utricle* compressed, indehiscent.

Distr. Large genus, centering in trop. America, some *spp.* native in Australia and SE. Malaysia, one an introduced ubiquist.

Of the species collected in Malaysia 3 are natives of America and have been introduced. The 2 other species are native both in Australia and in SE. Malaysia, and represent a distinct Australian element in the Malaysian flora.

Notes. The flowers are in this genus ♂, at least in the Malaysian *spp.* In those of an Australian specimen of *G. brownii* Moq. I could find no trace of an ovary. SCHINZ in ENGL. & PR. Nat. Pfl. 2c Aufl. 16c (1934) 26 describes this genus as lacking pseudo-staminodes. But on p. 79 of the same volume he figures 2 species with very distinct pseudo-staminodes.

KEY TO THE SPECIES

- 1. Bracteoles with a (*sometimes very narrow*) dorsal crest.
  - 2. Dorsal crest of the bracteoles well-developed, very distinct, dentate-serrate on the back.
    - 3. Head globose or depressed-globose,  $1\frac{3}{4}$ – $2\frac{1}{4}$  cm long when adult. Bracteoles deep purple, pink or white, 2– $3\frac{1}{4}$  mm broad (crest included). Lobes of the staminal tube at least partly obtuse or rounded, not or hardly longer than the unwithered anthers. . . . . 1. *G. globosa*
    - 3. Heads at first ovoid, afterwards more spiciform, cylindric,  $2\frac{1}{2}$ –5 cm long when adult. Bracteoles orange or reddish, 4–5 mm broad (crest included). Lobes of the staminal tube very acute, much longer than the unwithered anthers. Exclusively cultivated . . . . . 3. *G. haageana*
  - 2. Dorsal crest of the bracteoles very narrow, dorsally entire, not reaching up to the apex of the bracteole. Flowers white . . . . . 2. *G. celosioides*
- 1. Bracteoles without a dorsal crest.
  - 4. Adult heads 3–4 cm diam. Perianth much compressed, 12–14 mm long, much longer than the bracteoles. Tepals acute. Staminal tube with long filiform pseudo-staminodes between the filaments, free parts of the latter 5–6 mm long. Style 8–9 mm (spreading stigmas included), exceeding the stamens. Robust herb . . . . . 4. *G. canescens*
  - 4. Adult heads  $3\frac{1}{4}$ –1 cm diam. Perianth not or hardly compressed,  $3\frac{1}{2}$ –4 mm long, about equalling the bracteoles or slightly longer. Tepals rather obtuse. Staminal tube without pseudo-staminodes between the filaments, free parts of the latter  $\pm \frac{1}{2}$  mm long. Style  $\pm \frac{1}{2}$  mm (the erect minute stigmas included), not exceeding the stamens. Small herb . . . . . 5. *G. tenella*

1. *Gomphrena globosa* LINNÉ, Sp.Pl. (1753) 224; BURM. Fl. Ind. (1768) 72; BL., Bijdr. (1825) 548; BLANCO, Fl. Filip. (1837) 198; ed. 2 (1845) 139; ed. 3 (1877) 251, t. 78; DECNE in Nouv. Ann. Mus. 3 (1834) 372; SPAN. in Linnaea 15 (1841) 346; Moq. in DC. Prodr. 13, 2 (1849) 409; Miq. Fl. Ind. Bat. 1, 1 (1858) 1050; Suppl. (1860) 150; Hook. f. Fl. Br. Ind. 4 (1885) 732; BAILEY, Queensl. Fl. pt 4 (1910) 1235; PULLE in Nova Guinea 8 (1910) 352; KOORD. Exk. Fl. 2 (1912) 201; STUCHLÍK in FEDDE, Rep. XII (1913) 337 seq.; ASCH. & GR. Syn. 5, 1 (1914) 367; MERR. Interpr. Herb. Amb. (1917) 215; En. Born. (1921) 246; En. Philip. Fl.Pl. 2 (1923) 132; RIDL. Fl. Mal. Pen. 3 (1924) 10; HEYNE, Nutt. Pl. (1927) 609; BACKER, Onkr. Suiker. (1930) 231, Atl. t. 242; GAGN. in Fl. gén. I. C. 4 (1936) 1067.—

*Flos globosus* RUMPH. Herb. Amb. 5, 289, t. 100, fig. 2.—Fig. 8.

Annual, erect or at base decumbent and rooting, 15–60 cm high; stem thickened at base of internodes, often tinged with red, on young parts appressed pilose. *Leaves* oblong or oblong-obovate from an acute base, obtuse, often  $\pm$  undulate, thinly pilose on both surfaces, 5–15 by 2–6 cm; petiole 1– $1\frac{1}{2}$  cm; 2 topmost leaves sessile or nearly so. *Heads* sessile or subsessile above the topmost pair of leaves, solitary or sometimes in clusters of 2–4, globose or depressed globose,  $1\frac{3}{4}$ – $2\frac{1}{4}$  cm diam.; bracts ovate-triangular, acuminate, acute, 3–6 mm; bracteoles with very distinct dentate-serrate dorsal crest, much surpassing the bract, 7–12 mm by 2– $3\frac{1}{4}$  mm (crest included), deep purple,



pink or white. *Perianth* shorter than the bracteoles, yellowish green, white-woolly outside, 6–6½ mm long. Staminal tube about equalling the perianth; its lobes at least partly obtuse or rounded, not or hardly longer than unwithered anthers. Style much shorter than staminal tube, bifid. *Fruit* ovoid,  $\pm 2\frac{1}{2}$  mm; seed reniform, swollen.

*Distr.* Native of trop. America; long ago introduced into *Malaysia*: found throughout the Archipelago either cultivated or semi-naturalized.

*Ecol.* In settled areas in waste places not rarely found as a stray from gardens but nowhere firmly established, and not truly naturalized, 1– $\pm$  1300 m. *Fl. fr.* throughout the year.

*Uses.* Cultivated in gardens as an ornamental. Cooked leaves may be eaten.

*Vern.* *Bunga knop*, M.



Fig. 8. *Gomphrena globosa* L. from Java,  $\times \frac{1}{4}$ .

2. *G. celosioides* MART. Beitr. Amar. (1825) 93; MOQ. in DC. Prod. 13, 2 (1849) 410; SEUBERT in MART. Fl. Bras. 5, 1 (1875) 218; SANDW. in Kew Bull. (1946) 29; STEEN. in Bull. J.B.B. III, 17 (1948) 402.

Annual, erect or ascending, 10–25 cm long, often branched from the base; stem finely appressed-white-pilose; internode immediately beneath 2 top-most leaves often long. *Leaves* shortly petioled or subsessile, spatulate or oblong-lanceolate from an acute base, acute or rather obtuse, ending in a short rather hard point, glabrous or sparingly appressed pilose above, thinly or rather densely appressed pilose beneath, 2–4½ by ½–1¼ cm; 2 top-most leaves subsessile. *Heads* sessile above highest pair of leaves, at first subglobose,  $\pm 1$  cm diam., gradually lengthening into a spike, finally up to 4 cm long; receptacle long-white-woolly; bracts ovate, acuminate, very acute, 3–4 mm; bracteoles long-ovate, very acute, white,  $\pm 6$  mm, in the higher part with a dorsal crest; crest narrow, abruptly ending below top of the bracteole and there sparingly shortly, irregularly dentate, otherwise entire. *Perianth* inserted on a minute knob, pure white, somewhat shorter than the bracteoles, 4½–5½ mm. *Tepals* narrowly lanceolate, acute, in lower half externally densely clothed with long fine white hairs. *Stamens* slightly shorter than perianth; filaments nearly entirely connate; apical teeth of the staminal tube varying from rather obtuse to rather acute, not or shortly exceeding unwithered anthers,  $\pm \frac{2}{3}$  mm. Style much shorter than the staminal tube, bifid somewhat deeper than halfway down, totalling ¾–1 mm. *Ripe fruit* not seen.

*Distr.* Native of trop. America, introduced in trop. and S. Africa, India and Australia, in *Malaysia*: in Batavia, Manila (COERT no 1400, a. 3.6.36), and Singapore, well on its way to spread over the Old World. The statement of SANDWITZ *l.c.* that the plant has run wild all over the Botanic Gardens at Buitenzorg was due to misinformation.

*Ecol.* Roadside weed, between grass, locally gregarious, tufted in mats (Singapore, harbour-yard, 1926; Batavia, 1946), well adapted to hot, dry, dusty situations at low elevations.

3. *Gomphrena haageana* KLOTZSCH in OTTO & DIETR. Allg. Gartenz. 21 (1853) 297.

*For differentiating characters see the key to the species.*

*Distr.* Native of Mexico, in *Malaysia*: exclusively and occasionally cultivated.

4. *Gomphrena canescens* (POIR). R.Br. Prod. (1810) 416; Moq. in DC. Prod. 13, 2 (1849) 398; BTH. Fl. Austr. 5 (1870) 253; HEMSL. Rep. Bot. Chall. 1, 3 (1884) 184; BAILEY, Queensl. Fl. pt 4 (1901) 1235; STUCHLIK in FEDDE, Rep. XII (1913) 345; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 644.—*Philoxerus canescens* POIR. in LAMK. Tabl. Enc. Bot. Suppl. 4 (1816) 393.—*Gomphrena lanuginosa* SPAN. in Linnaea 15 (1841) 346, *ic. ined.* 51 (*non vidi*); MIQ. Fl. Ind. Bat. 1, 1 (1858) 1051.

Erect annual, 60–90 cm high, not or sparingly branched, stem hard, densely clothed with erect appressed long white hairs. *Leaves* sessile, linear

or narrowly linear-lanceolate, acute, firmly herbaceous with a strong midrib, on both surfaces densely clothed with appressed long white hairs,  $2\frac{1}{2}$ –5 cm by 2–5 mm. *Heads* subtended by an involucre of 5–9 patent cauline leaves, depressed globose, 3–4 cm diam.; involucre leaves narrowly linear, tapering to a very acute apex, 1-nerved, at the base long-ciliate, on both surfaces densely clothed with appressed long white hairs, 2–3 by 4–6 mm; receptacle densely long-white-woolly; bracts and bracteoles tapering from a broad base, bracts 6–7 mm long; bracteoles very acute  $\pm$  8 mm. *Flowers* between the bracteoles on a very short thick pedicel; perianth strongly compressed, purple, greatly surpassing the bracteoles 12–14 mm long. *Tepals* nearly free, lanceolate, acute, 1-nerved, in the lowest  $\frac{1}{3}$ – $\frac{1}{2}$  of the back (especially at the base) clothed with long hairs. *Stamens* 7–9 mm long, at the base for a length of 2–4 mm connate into a tube; free parts of filaments flat, glabrous 5–6 mm, alternating with shorter subulate acute anantherous pseudo-staminodes. *Ovary* glabrous; style glabrous, 8–9 mm, longer than the stamens, shortly bifid; arms spreading. *Fruit*?

Distr. N. Australia, in *Malaysia*: Lesser Sunda Isl. (Timor, SPANOGHE), Moluccas (Tanimbar, RIEDEL).

Ecol. Probably in sunny dry localities, in Timor on calcareous rocks, apparently rare, only twice collected.

**5. *Gomphrena tenella* (MOQ.) BTH.** Fl. Austr. 5 (1870) 256.—*Iresine tenella* Moq. in DC. Prod. 13, 2 (1849) 343.

Erect annual, Malaysian specimens only  $2\frac{1}{2}$ –6 cm high, unbranched; stem thin, hard, in higher

part densely woolly. *Leaves* in 2–4 distant pairs, narrowly linear, glabrous, above, thinly patently pilose beneath,  $\frac{1}{2}$ – $\frac{3}{4}$  cm long. *Heads* sessile above the topmost pair of leaves, globose,  $\frac{3}{4}$ –1 cm diam.; receptacle very densely clothed with longish white hairs; bracts ovate, shortly apiculate,  $\pm$   $2\frac{1}{2}$  mm long, much shorter than the bracteoles; axis of flower densely woolly; bracteoles ovate, acute,  $\pm$   $3\frac{1}{2}$  mm long. *Tepals* nearly free, oblong, rather obtuse,  $3\frac{1}{2}$ –4 mm long, in the lower half with an oblong herbaceous central field; this field on the back densely clothed with long, entangled, in dried specimens brownish hairs. Filaments connate up to near apex; staminal tube not shorter than ovary and style together; free parts of filaments  $\pm$   $\frac{1}{2}$  mm long, broad, slightly narrowed upwards, without intervening pseudo-staminodes. Style minute; stigmas 2, erect, subulate; style and stigmas together  $\pm$   $\frac{1}{2}$  mm long. *Fruit*?

Distr. N. Australia, in *Malaysia*: Moluccas or the Lesser Sunda Islands. The only specimen on which this record is based was collected by REINWARDT in 1821, and is preserved in the Rijksherbarium, Leyden. According to an accompanying note by BLUME it was collected somewhere in the Moluccas, but it may have been gathered in Flores Island.

Notes. I am not wholly satisfied that my identification of the specimen described above is correct. The dimensions of its vegetative parts are very much smaller than those given by MOQUIN and BENTHAM for Australian specimens. However, it is possible that REINWARDT collected the plant in a very sterile or arid locality. I have not examined any other specimen of this species.

## 16. IRESINE

P. BROWNE, Hist. Jamaica (1756) 358.

Erect, ascending or scandent herbs or undershrubs. *Leaves* opposite, petioled, entire or subentire. *Flowers* ( $\sigma$ ) ( $\rho$ ) or  $\rho$ , paniculate; panicles terminal, often also in the highest leaf axils, many-flowered; their ultimate branches spiciform, bearing solitary or clustered, minute flowers; flowers solitary in axil of bract, subtended by 2 bracteoles, membranous, usually shining, subglabrous or woolly. *Tepals* 5, oblong or ovate-oblong, acute; stamens (in  $\rho$  reduced to very minute staminodes) 5; filaments at the base connate in shallow cup, filiform, with or without interposed pseudo-staminodes; these usually short, broadly triangular, rarely long; anthers oblong, 1-celled (2-locellate); ovary (wanting in  $\sigma$ ) compressed, ovule 1, pendulous from an erect funicle; style very short; stigmas 2, subulate, erect-ascending, short; utricle compressed, orbicular, thin-walled, indehiscent; seed lenticular or reniform, shining.

Distr. Large genus, centering in America, also in the Galapagos Isl., in *Malaysia*: one Brazilian species cultivated and locally naturalized.

**1. *Iresine herbstii* HOOK. f.** in Gard. Chron. (1864) 654, 1206; Bot. Mag. (1865) t. 5409; ASCH. & GR. Syn. 5, 1 (1914) 369; MERR. En. Philip. 2. (1923) 132; HEYNE, Nutt. Pl. (1917) 609; BAILEY, Stand. Cycl. 2 (1935) 1662; BACKER, Bekn. Fl. Java

(emerg. ed.) IV A, fam. 63 (1942) 12.—*Iresine celosioides* (non LINNÉ!) BOERL. in Verh. 2e Genées- en Nat. Congr. Leiden (1889) 148; BACKER, Ann. J. B. B. Suppl. 3 (1909) 405; KOORD. Exk. Fl. 2 (1912) 201.

Perennial herb, erect or ascending, often much branched, slightly fleshy; nodes thickened; base of the internodes in dried specimens strongly constricted; young stems pubescent, especially on and near nodes. *Leaves* broadly ovate-orbicular, broadly oval or broadly obovate, at the frequently slightly unequal base very obtuse, rounded or truncate but shortly contracted into the petiole, with a usually more or less deeply emarginate but sometimes rounded or shortly acuminate and then very acute apex, entire or subentire, concave, thinly fleshy, either shining dark red with lighter coloured bands along the main-nerve or (*var. aureo-reticulata* NICH.) green with golden yellow bands, on both surfaces very thinly clothed with shining brown or yellowish, partly bifid and appressed hairs,  $2\frac{1}{2}$ –8 cm long and wide; petioles 1–5 cm; those of a single pair connected at the base by a transverse row of longish, thickish, harticulate hairs. *Panicles* terminal and often also in axils of the highest and then small leaves, 5–50 cm long, united in a terminal, erect, 8–60 cm long, often much branched and rich-flowered panicle; primary branches of the panicle erecto-patent, branched from base or nearly so; ultimate branchlets spiciform, rather dense-flowered, 1–4 cm long; rachises of the panicle thin, red, at first rather densely clothed with longish shining hairs; glabrescent. *Flowers*

not concealing the rachis, in *Malaysia exclusively* ♀; bracts, bracteoles and perianth greenish white or yellowish white; bracts and bracteoles persistent after fall of the perianth, ovate, rather acute, concave, nerveless, glabrous; bracts  $\pm$  1 mm long; bracteoles slightly wider,  $\pm$   $1\frac{1}{4}$  mm long. *Perianth*  $\pm$   $1\frac{1}{4}$  mm long, at the base externally with a dense whorl of long, very thin, white hairs; tepals dorsally with a few short hairs, otherwise glabrous, oblong, rather acute, nerveless; pseudo-staminodes minute. Ovary suborbicular, much compressed, glabrous; stigmas obliquely patent-ascending,  $\pm$   $\frac{1}{2}$  mm. *Fruit* never produced in Malaysia.

*Distr.* Native of Brazil, in *Malaysia*: exclusively cultivated for ornamental purposes (already before 1894) and locally naturalized in *e.g.* Java, Celebes, and Ceram.

*Ecol.* Naturalized in forest borders and along forest paths, 500–1500 m, locally abundant.

*Uses.* The leaves are squeezed in water in order to obtain a red dye used for colouring agar agar jellies.

*Vern.* *Bayam merah*, M.

*Notes.* In *Malaysia* exclusively ♀ flowers are found. In none of the many specimens I examined, I have found ♂ flowers nor have I traced any description of them. *Fruit* is never produced in *Malaysia*.

#### Excluded

*Nevrolis fuscata* RAFINESQUE, *Autikon Bot.* (1840) 150. This new genus was based by RAFINESQUE on *Celosia virgata* HORT. (*non* JACQ.). Its native origin was cited as: 'Borneo or Moluccas?' I cannot identify this with certainty. It is possible that MERRILL

(*Rafin. p.* 119) is right in reducing it to *Celosia*. RAFINESQUE might have had a specimen belonging to a garden form of JACQUIN's species which is native in South America.

## CHENOPODIACEAE (C. A. Backer, Heemstede)

Annual or perennial herbs or shrubs, often fleshy, glabrous, papillate or hairy. *Leaves* opposite or alternate, exstipulate, sometimes seemingly wanting, stalked or sessile, entire, dentate-serrate-lobed or irregularly gashed. *Flowers* solitary, 2–3-nate or glomerate, usually sessile, either axillary or in terminal or axillary dense or interrupted spikes or panicles, ♂ or unisexual, monochlamydous, rarely achlamydous, small; bracts present or absent, usually small, rarely leafy. *Perianth* herbaceous or sometimes scarious, rarely (in ♀) absent, 3–5-partite with (in bud) imbricate segments, or sometimes almost entirely gamophyllous and then shortly lacerate-dentate or unilaterally cleft, persistent, after anthesis accrescent or not. Stamens often the same number as tepals and opposite to them, sometimes fewer, usually inserted on or near base of perianth; filaments free or shortly connate; anthers dorsifixed or inserted in a basal cleft, 2-celled (4-locellate); cells bursting longitudinally. Ovary free or at the base adnate to the perianth, 1-celled; ovule 1, basal, sessile and erect or suspended from a funicle; styles or stigmas 2–5, linear. *Utricle* either enclosed by the perianth or not, indehiscent or rarely operculate; seed erect, oblique or horizontal, usually compressed; endosperm mostly present, peripheral, surrounding the embryo; embryo annular or spirally twisted.

*Distr.* Species numerous, inhabitants of the temperate and tropical zones of both hemispheres.

*Ecol.* Often in maritime, saline, or in permanently or periodically dry regions. Many are weeds of cultivation. In Malaysia restricted to maritime and mountainous districts.

*Uses.* In Malaysia some species are cultivated as vegetables, others as medicinal or ornamental plants, but *not* for the production of sugar.

### (ARTIFICIAL) KEY TO THE GENERA

1. Apparently leafless; stem spuriously articulate. Leaves decussate; those of each pair connate throughout their length into a tubular fleshy sheath which tightly and entirely encloses the appertaining internode and is widened at the apex into a shallow cup. Flowers spicate; bracts decussate, crowded; flowers in the axil of one bract  $\pm$  collateral; perianth gamophyllous, scarious,  $\pm$  flagon-shaped; stamen 1 (sometimes 2?).
2. Floral bracts almost entirely connate into a cup; base of the cup on 2 opposite sides provided with collateral apertures for the protrusion of stamens and stigmas. Apex of perianth laterally split. **5. Arthrocnemum**
2. Floral bracts almost free; their margin dilated into a patent semi-orbicular scale, their base without apertures. Apex of perianth shortly dentate-lacerate . . . . . **4. Tecticornia**
1. Leafy in a normal way; leaves alternate.
3. Leaves spine-tipped. Bracts exceeding the perianth. Tepals about the middle with a transverse thickening, above this thickening scarious . . . . . **7. Salsola**
3. Leaves not spine-tipped. Tepals without a transverse thickening.
4. Leaves sessile, narrowly linear, semi-terete, very succulent. Bracteoles distinct though small, transparent, after anthesis stellately spreading . . . . . **6. Suaeda**
4. Leaves distinctly petioled, flat.
5. Flowers (♂) (♀); ♂ flowers in spicate or paniced clusters; ♀ flowers solitary in leaf axils. No bracteoles. In Malaysia exclusively cultivated. . . . . **3. Spinacia**
5. Flowers all clustered, all or for the greater part ♂; the ♀, when present, in the same cluster as the ♂ ones.
6. Ovary free. Flowers after anthesis not coalescent. No bracteoles . . . . . **2. Chenopodium**
6. Ovary adnate to base of perianth. Flowers coalescent after anthesis. Bracteoles minute. In Malaysia only cultivated . . . . . **1. Beta**

### 1. BETA

LINNÉ, *Sp. Plant* (1753) 222.

In Malaysia not wild; 1 species frequently cultivated in the mountainous regions of Java.

**1. *Beta vulgaris* LINNÉ**, Sp. Plant. (1753) 222; ASCH. & GR. Syn. 5, 1 (1913) 12; OCHSE & BAKH. v. D. BR. Veget. (1931) 102.

In Java 2 forms cultivated, exclusively for the European table, not eaten by the Indonesians, both of them unfit for the manufacture of sugar:

*f. cicla* [LINNÉ, Sp. Plant. (1753) 222, *pro sp.*]. Dutch: *Snijbiet*. Leaves eaten as spinach; root rather tough, unfit for human food.

*f. rapa* [DUM., Fl. Belg. (1827) 21 *pro sp.*]. Dutch: *Kroot, roode biet*. Leaves not eaten. Root fleshy, dark red, edible after cooking.

## 2. CHENOPODIUM

LINNÉ, Sp.Pl. ed. 1 (1753) 218.

Annual or perennial herbs, sometimes strongly smelling; young parts often more or less densely clothed with minute, powdery, white or pink vesicles which, when young, contain a watery liquid but usually soon shrivel and lose their colour. *Leaves* alternate, petioled, herbaceous, variable as to shape, entire, dentate-serrate or irregularly gashed. *Flowers* ♂ or by abortion ♀, sessile, clustered; clusters solitary in the leaf axils or in axillary and terminal cymes, spikes or panicles; no bracteoles. *Tepals* 5 or sometimes 4, free or shortly connate, vaulted, herbaceous, often longitudinally thickened or keeled on the back, in the Malaysian species not fleshy after anthesis. Stamens in ♀ the same number as tepals, inserted on the base of the perianth or free from it, at the base sometimes connate into a fleshy disk. Ovary depressed globose; style short; stigmas 2–5. *Fruit* often embraced by conniving tepals, thin-walled indehiscent. Seed usually horizontal, sometimes oblique or vertical, shining or dull, smooth or finely tuberculate, lenticular; its margin keeled or not; testa thinly coriaceous; embryo annular, surrounding the usually mealy endosperm.

Distr. Species about 60 in the temperate zones of both hemispheres. A small number naturalized in the mountainous districts of the tropics.

Ecol. For the greater part weeds of cultivation; many prefer a fertile soil.

Uses. A few species cultivated either for their oil-producing fruits, as a substitute for tea, or for ornamental purposes.

Notes. Most species flower and fruit freely. For the determination ripe fruits are of value. The colour of young leaves should be noted by Collectors.

BURMAN (Fl. Ind. (1768) 72) records *Chenopodium urticum* L. as having been sent to him from Java. The specimen mentioned by him is conserved at Geneva and has been correctly named. Nevertheless I have omitted the species from my key as I feel not at all convinced that it was really collected in Java; BURMAN was often not careful in his records. *Ch. urticum* was never afterwards collected in Malaysia.

### KEY TO THE SPECIES

1. Top of ovary and fruit studded with (*in vivo* yellow) glands; stigmas 2–5; embryo encircling only  $\frac{1}{2}$ – $\frac{2}{3}$  of the seed. Young vegetative parts and outside of perianth without powdery white or pink vesicles. Undersurface of leaves with (sometimes rather indistinct) yellow glands. Strongly smelling. **1. *Ch. ambrosioides***
1. Top of ovary and fruit glandless; stigmas 2; embryo encircling almost the entire seed. Young vegetative parts and outside of perianth with powdery white or pink vesicles. Leaves without any yellow glands. Not or faintly smelling.
  2. Segments of perianth after anthesis widely patent, not covering the fruit. Young parts without powdery vesicles, quite glabrous. **2. *Ch. polyspermum***
  2. Segments of perianth after anthesis connivent, covering the fruit. Young, or at least very young, parts with powdery white or red vesicles.
  3. Only very young parts with distinct vesicles; these white, very soon shrivelling and losing their colour; old leaves on *both surfaces* dark green and feebly shining. Seed (after removal of pericarp) dull black, rather obscurely papillate. Panicles small; terminal panicle not much larger than the axillary ones. **3. *Ch. murale***
  3. Vesicles white or red, not very soon losing their colour; old leaves *not* dark green on *both surfaces*.
  4. Larger leaves irregularly and rather coarsely serrate-dentate-laciniate or deeply gashed, often longer than 5 cm and wider than 3 cm; undersurface of leaves not very densely and persistently vesiculose. Seed after removal of pericarp shining blackish brown, almost smooth. **4. *Ch. album***

4. Leaves quite entire, small (mostly 2–4 by  $1\frac{1}{2}$ –3 cm), on the undersurface very densely and persistently vesiculose; hence in a *dried state* very pale beneath; their nerves and margins often reddish. Flower-clusters spicate; higher spikes united in a terminal, small, leafless, paniculate inflorescence; rachises of the inflorescence and outside of the perianth densely clothed with patent, oblong, reddish vesicles . . . . . 5. *Ch. acuminatum*

**1. *Chenopodium ambrosioides* LINNÉ, Sp.Pl. (1753) 219; BLANCO, Fl. Filip. (1837) 200; ed. 2 (1845) 140; ed. 3, 1 (1877) 253, tab. 69; MOQ. in DC. Prod. 13, 2 (1849) 72; WIGHT, Ic. 5 (1852) tab. 1786; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1017; BTH. Fl. Austr. 5 (1870) 162; HOOK. f. Fl. Br. Ind. 5 (1886) 4; BAILEY, Queensl. Fl. pt 4 (1901) 1243; KOORD. in Nat. Tijdsch. N.I. 60 (1901) 256; BACK. in Ann. J.B.B. Suppl. 3 (1909) 398; COURCH. in Fl. gén. I.C. 5 (1910) 5; MERR. Fl. Man. (1912) 189; KOORD. Exk. Fl. 2 (1912) 189; ASCH. & GR. Syn. 5, 1 (1913); MERR. Sp. Blanc. (1918) 136; En. Philip. Fl.Pl. 2 (1923) 125; HEGI, Ill. Fl. Mitt. Eur. 3 (1912) 233; HEYNE, Nutt. Pl. 2 (1927) 602; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 618; BURK. Dict. Ec. Pr. 1 (1935) 523.**

Erect or ascending annual, often very much branched; entire plant strongly smelling, without powdery vesicles, 15 cm to 1 m high; stem angular-ribbed, glabrous or finely pubescent. *Leaves* oblong-lanceolate from a narrowed or contracted, acute, often more or less decurrent base, acute or rather obtuse; larger ones coarsely or shallowly serrate-dentate; smaller ones less deeply incised; highest entire, gradually changing into bracts; all leaves herbaceous, bright green, on the undersurface more or less densely studded with *in vivo* yellow (sometimes very inconspicuous) glands, otherwise subglabrous or sparingly beset with short white hairs,  $1\frac{1}{2}$ –15 by  $\frac{1}{2}$ –5 cm; midrib prominent beneath; other nerves thin; petioles short or medium-sized; those of highest leaves obsolete. *Flower-clusters* small, 3–25-flowered, in the axils of successive, conspicuous, narrow,  $\pm$  bractlike leaves, united in short or longish, rather lax spikes, forming together a leafy panicle; floral leaves much surpassing the clusters, acute, with a strongish midrib. *Flowers*  $\sigma$  or partly  $\sigma$ , sometimes partly  $\sigma$  and then with 4–5 stamens and a rudimentary, densely glandular ovary. *Perianth* light green with a pale base,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long, 4–5-cleft to near the base; segments ovate-triangular, rather acute, very concave, not or indistinctly keeled. Stamens in  $\sigma$  4–5, rarely 1–3; filaments slightly exceeding the perianth. Ovary depressed globose, on top with many small, *in vivo* yellow glands; stigmas 2–5, usually 3 or more. Ripe *fruit* entirely concealed by the conniving tepals. *Seeds* horizontal, or a few (rarely many or all) erect, broadly oval-obovoid, shining brownish black,  $\frac{2}{3}$ – $\frac{4}{5}$  mm diam.; embryo encircling  $\frac{1}{3}$ – $\frac{2}{3}$  of the seed.

**Distr.** Native of tropical America, introduced in many other regions: Europe, Asia, Africa, Australia, in *Malaysia*: naturalized throughout the Philippines, in Java and in N. Celebes (Minahasa). At present found in a wild state in the western and the eastern part of Java between 1600 and 2000 m.

**Ecol.** Road-sides, locally often very numerous. In Celebes collected in dry ricefields. *Fl.* Jan.–Dec.

**Uses.** The slightly poisonous oil distilled from the seeds is used as a remedy against ankylostomiasis. For this purpose the plant has been cultivated in Java, but its cultivation was abandoned as being insufficiently remunerative.

**Notes.** In Java the seeds are all or nearly all horizontal. The Celebian specimen has *vertical* seeds (see also the description by MOQUIN, *l.c.* p. 73) but in all other respects it completely agrees with the Javan material. It was collected in 1840 by FORSTEN and had as late as 1949 still distinctly retained its peculiar smell.

**2. *Chenopodium polyspermum* LINNÉ, Sp.Pl. (1753) 220; MOQ. in DC. Prod. 13, 2 (1849) 62; ASCH. & GR. Syn. 5, 1 (1913) 26; HEGI, Ill. Fl. Mitt. Eur. 3 (1912) 222; MERR. in Philip. J.Sc. 5 (1910) Bot. 145; En. Philip. Fl.Pl. 2 (1923) 126.**

Annual, erect or ascending, quite glabrous, glandless, without a distinct smell, without powdery vesicles, 4–100 cm (mostly 15–75 cm) long, dull green, rarely shining, in a living state often more or less strongly tinged with purple, frequently much branched (often from quite near the base); branches obliquely erect or the lower widely patent-ascending, not rarely partly prostrate; stem and branches angular. *Leaves* herbaceous, rarely fleshy, entire or the larger ones sometimes with one or a few triangular teeth near the base; lower leaves on rather long petioles, ovate or ovate-oblong from a cuneate or obtuse, rarely hastate base, shortly contracted into the petiole, acute or obtuse, rarely subretuse, frequently very shortly mucronate, 4–11 by  $1\frac{1}{2}$ –6 cm; highest leaves much smaller, oblong-lanceolate. *Cymes* very numerous, most variable as to size, dense or rather loose, few to many-flowered; highest very often collected in a narrow, paniculate inflorescence (reminiscent of *Amaranthus gracilis*). *Flowers* sessile; tepals oval-obovate or oval-oblong, obtuse, thin, with a very distinct, not-keeled midrib,  $1\frac{1}{3}$ – $1\frac{1}{2}$  by  $\frac{1}{3}$ – $\frac{1}{2}$  mm, after anthesis widely patent, not concealing fruit; stamens 5, on the base of the perianth,  $\pm$  equalling tepals; stigmas 2, erect or suberect, minute, persistent. *Fruit* depressed-globose,  $\pm$   $\frac{1}{3}$  mm diam., very thin-walled. Seed blackish brown, feebly shining, very faintly striolate.

**Distr.** Europe, continental Asia; elsewhere locally introduced.

**Ecol.** Weed of fields and gardens; waste places.

**Notes.** I have seen no Malaysian specimen but MERRILL *l.c.* records the plant as a casual weed in the Philippines. The species is very variable.

**3. *Chenopodium murale* LINNÉ Sp.Pl. (1753) 219; MOQ. in DC. Prodr. 13, 2 (1849) 69; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1016; BTH. Fl. Austr. 5 (1870) 160; HOOK. f. Fl. Br. Ind. 5 (1886) 4; BAIL. Queensl. Fl. pt 4 (1901) 1243; KOORD. in Nat. Tijdsch. N.I. 60**

(1901) 256; BACK. in Ann. J.B.B. Suppl. 3 (1909) 398; KOORD. Exk. Fl. 2 (1912) 190, 191; ASCH. GR. Syn. 5, 1 (1913) 33; HEGI, Ill. Fl. Mitt. Eur. 3 (1912) 223; DOMIN, Beitr. Pflanzengeogr. Austr. 1, 2 (1929) 618.

Annual, erect or ascending, often much branched, slightly fetid, without any yellow glands, 15–80 cm long; all vegetative parts and outside of perianth, when very young, clothed with white, powdery vesicles, otherwise glabrous; vesicles soon shrivelling up and losing their colour; stem and leaves then darkgreen, somewhat shining; stem angular or ribbed; leaves ovate-rhomboid-elliptic-oblong from a cuneate base, acute, irregularly coarsely acutely dentate-serrate, herbaceous,  $1\frac{1}{2}$ –12 by  $\frac{3}{4}$ – $7\frac{1}{2}$  cm; petioles of lower leaves 3–5 cm, of higher leaves gradually smaller, of topmost ones often very short. Flowers in axillary and terminal, 1–4 cm long panicles with erecto-patent branches, densely clustered, 5-merous; ♂; terminal panicle not or hardly longer than the axillary ones; perianth herbaceous. Tepals distinctly connate at the base, oval, with rounded or very obtuse tips, faintly keeled on the back,  $1\frac{1}{2}$ –2 mm long; stamens 5, on the very base of the perianth; stigmas 2, short. Fruit tightly enclosed by incurved tepals, depressed globose,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm diam.; pericarp very thin, not readily separating from the seed. Seed horizontal, encircled by a very distinct rather sharp keel; testa (after removal of the pericarp) dull black, very finely papillate; embryo encircling almost the entire seed.

Distr. Possibly originating from continental Asia but since long widely spread in Europe, America, Africa and Australia. In *Malaysia*: introduced in Java already more than 90 years ago, but as yet still confined to Mt Tengger in the eastern part between 1900 and 2300 m.

Ecol. Fields and gardens, road-sides, locally very common.

Vern. *Dieng*, *J, dieng dempo*, *J, dieng idjo*, *J*.

4. *Chenopodium album* LINNÉ, Sp. Plant. (1753) 219; MOQ. in DC. Prod. 13, 2 (1849) 70; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1017; BTH. Fl. Austr. 5 (1870) 159; HOOK. f. Fl. Br. Ind. 5 (1886) 3; BAIL. Queensl. Fl. pt 4 (1901) 1242; KOORD. in Nat. Tijd. N.I. 60 (1901) 256; BACK. in Ann. J.B.B. Suppl. 3 (1909) 398; KOORD. Exk. Fl. 2 (1912) 191; ASCH. & GR. Syn. 5, 1 (1913) 38; HEGI, Ill. Fl. Mitt. Eur. 3 (1912) 225; DOMIN, Beitr. Pflanzen geogr. Austr. 1, 2 (1929) 617.

Erect annual, often much branched, not markedly smelling, without any yellow glands, 15 cm– $1\frac{1}{2}$  m high; all vegetative parts and outside of perianth, when young, densely clothed with white or partly amaranthine powdery vesicles, otherwise glabrous; the amaranthine vesicles soon turning white; all old vesicles shrivelling up and losing their colour. Stem angular, ribbed, with longitudinal dark green or red streaks. Lower leaves long-petioled, ovate-rhomboid, irregularly and rather coarsely dentate-serrate-laciniate or deeply gashed; higher ones gradually shorter-petioled, elliptic-oblong-lanceolate from an acute or contracted

base, acute or obtuse, less deeply incised or entire; all leaves herbaceous,  $1\frac{1}{2}$ –15 by  $\frac{1}{2}$ –13 cm. Flowers in panicked clusters, 5-merous, ♂; panicles often collected in a large terminal leafy paniculate inflorescence. Perianth herbaceous, not becoming fleshy after anthesis. Tepals distinctly connate at the base, oval, very concave, obtuse, with a strong, rounded midrib,  $1\frac{1}{2}$ – $2\frac{1}{4}$  mm long. Stamens slightly longer than the perianth. Ovary depressed globose; stigmas 2, short. Fruit in the living plant en-

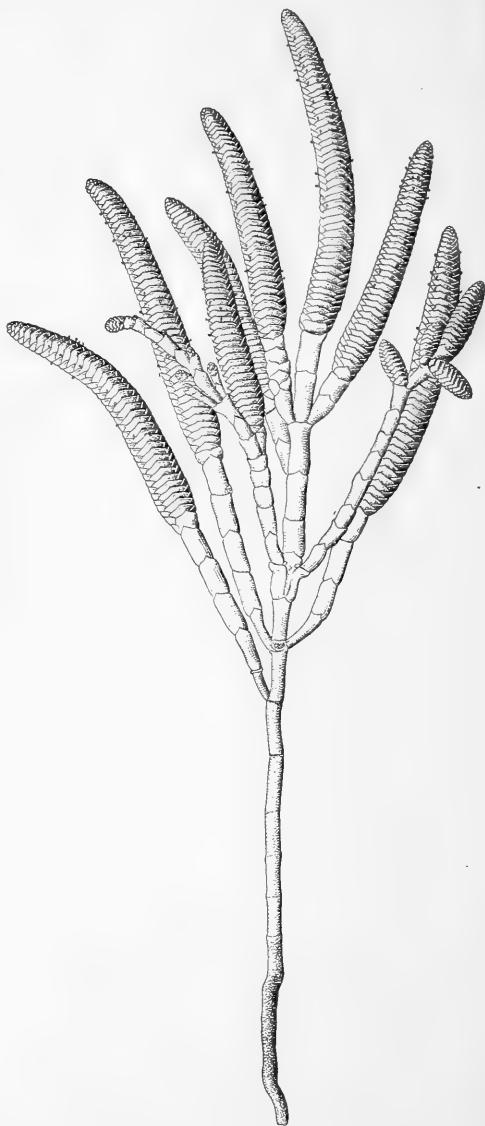


Fig. 1. *Tecticornia cinerea* (F.v.M.) BAIL. from saline coastal flats N of Mt Baluran; drawn after a living specimen by A. HAMZAH, Nov. 1941,  $\times \frac{1}{2}$ .

tirely enclosed by the incurved tepals, depressed-globose, finely papillate. Seed horizontal, lenticular, surrounded by an obtuse keel, shining blackish brown, smooth or nearly so,  $1\frac{1}{4}$ – $1\frac{3}{4}$  mm diam.

Distr. Europe, continental Asia, Africa, Australia, America, in *Malaysia*: in Java introduced already very long ago, naturalized in the eastern part of the island, 800–1800 m.

Ecol. Fields, gardens, locally common.

Vern. *Dieng*, J, *dieng putih*, J.

Notes. Extremely polymorphous, buried by fanatic species-splitters under a mountain of unnecessary and useless names.

*subsp. amaranthicolor* COSTE & REYN. in Bull. Herb. Boiss. II, 5 (1905) 979; HEYNE, Nutt. Pl. (1927) 602. —*Chenopodium amaranticolor* (COSTE & REYN.) COSTE & REYN. in Bull. Soc. Bot. Fr. 54 (1907) 181; ASCH. & GR. Syn. 5, 1 (1913) 66.

Young parts and outside of perianth densely clothed with amaranthine vesicles, retaining their colour during a long time but at last turning pale and shrivelling. Plant up to  $2\frac{1}{2}$  m high. Otherwise like the main species and in a dried state indistinguishable from it. Introduced in Java long ago, at present naturalized in the western and the eastern part between 1200 and 2300 m above sea-level. Roadsides, fields, locally often numerous. By the Indonesians sometimes cultivated as a vegetable.

Note. In a living state very conspicuous by the bright amaranthine colour of the young parts. A specimen (LÖRZING 7168) of *Ch. album* was in 1920 collected in N. Sumatra. I have seen it only in a dried state and it bears no note indicating the colour of the young leaves, so that it is impossible to make out whether it belongs to the typical species or to its *subsp. amaranticolor*.

5. *Chenopodium acuminatum* WILLD. (*non* SCHUR) Acta Nat. Cur. 2 (1799) 124, tab. 5, fig. 2; Moq. in DC. Prod. 13, 2 (1849) 62; MERR. in Philip. J. Sc. 3 (1908) Bot. 405; En. Philip. Fl. Pl. 2 (1923) 125.

Annual, erect or ascending, 20–30 cm high, branched or not; all young parts, especially under-surface of leaves, clothed with oblong, red or white vesicles; stems and branches angular; branches obliquely erect; their vesicles, except on the angles, subsistent. Leaves entire, in *sicco* thickish, retaining their indumentum of vesicles during a long time especially on the undersurface where it is very dense, hence in *sicco* very pale beneath, often with a reddish margin and a reddish undersurface of nerves; lower leaves on rather long, reddish vesiculose petioles, ovate from a very obtuse or rounded-subtruncate, shortly contracted base and an obtuse or rounded, very shortly pointed apex, 2–4 by  $1\frac{1}{2}$ –3 cm; higher leaves on shorter petioles, shorter, narrower, acute, distinctly and finely acuminate. Rachises of inflorescence densely clothed with reddish vesicles. Flower-clusters subglobose, small, dense, spicate, crowded or the lower rather distant; higher spikes united in a terminal, rather small leafless paniculate inflorescence. Flowers sessile, outside densely reddish-vesiculose. Tepals 5, broadly oval, obtuse or rounded, very concave thin, 1-nerved,  $1\frac{1}{3}$ – $1\frac{1}{2}$  mm long, before and after anthesis connivent. Stamens 5, about equalling the perianth; anthers thick; ovary (in our specimens) minute. Style short, 2-armed. Fruit (not seen) finely wrinkled; seed dull black or shining.

Distr. Siberia, China, Japan, Formosa; in *Malaysia*: Philippines (Batan Isl., between Formosa and Luzon).

Ecol. Waste places.

Note. I could examine only 2 specimens, neither of them collected in Malaysia.

### 3. SPINACIA

LINNÉ, Sp. Pl. (1753) 1027.

In Malaysia not wild; 1 species, the true spinach, occurs but rarely cultivated.

1. *Spinacia oleracea* LINNÉ, Sp. Pl. (1753) 1027, the true spinach, is but very rarely cultivated in Malaysia and only by way of experiment. It is substituted by two quite different species, *Amaranthus*

*tricolor* L. (*Amaranthaceae*), bayam, and *Tetragonia expansa* MURR. (*Aizoaceae*), New-Zealand spinach, kabak, M.

### 4. TECTICORNIA

HOOK. f. in BTH. & HOOK. f. Gen. Pl. 3 (1880) 65.

Only seemingly jointed and leafless, glabrous, softly succulent herb. Leaves decussate; those of each pair connate throughout their length in a tubular fleshy sheath tightly and entirely enclosing the appertaining internode and widened at the apex into a shallow, faintly bilobed cup, which embraces the slightly attenuate base of the next higher sheath. Flowers minute, spicate; spikes terminal and frequently also in highest leaf axils, oblong or shortly cylindrical, very obtuse, bracteate; bracts decussate, densely crowded, almost free, not provided with basal apertures, fleshy; their margin dilated into a semi-orbicular,  $\pm$  patent, thin-margined scale. Flowers often in threes, sessile, collateral, ♀; perianth flask-shaped, very thin, with



a narrow, dentate-lacerate mouth. Stamen 1; filament short; anther exsert, oblong-linear. Ovary ovoid-oblong, compressed, narrowed into a longish, shortly bifid style; ovule subsessile. *Utricle* erect, pericarp very thin, hyaline. Seed oblong, compressed, densely papillate; albumen hard; embryo slender, radicle inferior.

Distr. Monotypic, Australia and *S. Malaysia*.

**1. *Tecticornia cinerea* (F.v.M.) BAIL.** Queensl. Fl. 4 (1901) 1261; VALET. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 9; KOCH in ZW. Nieuw-Guin. Exp. 1904/5 (1908) 505; PULLE in Nova Guin. 8 (1910) 349.—*Halocnemum cinereum* F.v.M. Fragn. 1 (1858) 140.—*Salicornia cinerea* F.v.M. Fragn. 6 (1868) 251.—**Fig. 1.**

Perennial (?), much branched, erect or prostrate with erect branches, 15–30 cm long; young stems after removal of leaf-sheaths thinly wiry, tough; old stems rather robust, cylindrical, woody; adult internodes 1–2 cm; whole plant in a dried state greyish. *Spikes* usually 1 terminal and 2–6 in higher axils; the latter spikes opposite, widely patent,  $1\frac{1}{2}$ – $2\frac{1}{4}$  cm long. *Utricle* brown,  $1\frac{1}{4}$ – $1\frac{3}{4}$  mm long; seed yellowish brown.

Distr. N. Australia, in *Malaysia*: SW. New Guinea, S. coast near Merauke, (long.  $140^{\circ}$  E, G. M. VERSTEEG 1895; 8.9.07, KOCH *s.n.*) and coast near Mt Baluran, E. Java (long.  $114^{\circ}25'$  E, HOOGERWERF *s.n.* Nov. 1941).

Ecol. Low, clayey, seasonally swampy and again completely desiccating localities, cut up after a prolonged dry period in their upper layers into hard clumps by criss-crossing cracks, locally gregarious. According to KOCH the loamy plain was inundated in the rainy season, and had (had) probably connection with the mouth of the Digul river; possibly the soil was, therefore, saline. It is also said to have been collected in *Imperata*-fields, but we should bear in mind that non-botanists are apt to confound *Imperata* with other grasses.

Notes. Making an accurate detailed description of this species based on herbarium-specimens is impossible, owing to the extreme shrinking of dried materials and their pappiness after soaking. A new description after the living plant is urgently needed. Though HOOKER based his new genus *Tecticornia* on this species only, he did not create the binomium, which is often wrongly ascribed to him.

## 5. ARTHROCNUM

MOQ. Chenop. Enum. (1840) 111.

Only seemingly jointed and leafless herbs or undershrubs. *Leaves* decussate; those of each pair connate almost throughout their length in a tubular fleshy sheath, tightly and entirely enclosing the appertaining internode and widened at the apex into a rather shallow, faintly 2-lobed cup which embraces the shortly attenuate base of the next higher sheath. *Flowers* minute, spicate; spikes terminal, on often very short lateral branches, bracteate; bracts crowded, decussate, pairwise connate into a very faintly 2-lobed cup, embracing the base of the next higher cup; cups very fleshy at base, gradually thinner upwards, at the base on 2 opposite sides with 3 small collateral apertures for the protrusion of the adult anthers and stigmas (over the margin of the next lower cup); pairs of aperture-triads decussate. *Flower* usually 1 behind each aperture, ♀ or unisexual; bracteoles narrowly linear-spathulate, thinly membranous. Perianth thinly membranous, gamophyllous, at the apex or also deeper unilaterally cleft. Stamen 1 (sometimes 2?); filament short; anther thick. Ovary membranous; stigmas 2, subulate, rather long. *Utricle* (not seen in a ripe state) membranous or hard. Seed compressed; albumen well-developed, one-sided, mealy; embryo comma-shaped.

Distr. Species  $\pm 12$ , along the Mediterranean coast and in the warmer regions of N. America, Asia and Australia, in the coastal districts and salt-marshes, in *Malaysia* 1 species.

**1. *Arthrocnemum indicum* (WILLD.) MOQ.** Chenop. Enum. 113; in DC. Prod. 13, 2 (1849) 151; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1020; FORB. Nat. Wand. (1885) 515; HOOK. f. Fl.Br. Ind. 5 (1886) 12.—*Salicornia indica* WILLD. in Nova Acta Hist. Nat. 5, 111, t. 4, fig. 1; ROXB. Fl. Ind. ed. 1, 1 (1820) 185;

DECNE in Nouv. Ann. 3 (1834) 370; SPAN. in Linnaea 15 (1841) 345; WIGHT, Ic. 3 (1845) 737.—*S. fruticosa* DECNE (non L.) in Nouv. Ann. 3 (1834) 370; SPAN. in Linnaea 15 (1841) 345.—*Salicornia spec.* in ZOLL. Syst. Verz. (1854) 108, Z. 3339 (*sphal-mate* 3329).—*S. brachiata* MIQ. (non ROXB.) Fl.

Ind. Bat. 1, 1 (1858) 1019; KOORD. Exk. Fl. 2 (1912) 192.—*Salicornia australasica* Moq. (*ubi?*) ex SCHOLZ in E. & P. ed. 2, 16c (1934) 552.

Rather robust perennial herb, woody beneath, divaricately branched from the base; branches ascending, much divided; young shoots after removal of leaf sheaths very thin, wiry, afterwards growing thick and woody, not breaking up into joints. *Leaf sheaths* on young branches 7–10 mm long; their widened top with a thin, very minutely dentate upper margin, gradually drying up, long persistent. *Spikes* erect or erecto-patent, cylindrical, very obtuse,  $1\frac{1}{2}$ – $4\frac{1}{2}$  cm long, distinctly thicker than the branches by which they are borne; bracteal cups 12–30, from the narrowed base to the upper margin  $2\frac{1}{2}$ –3 mm long, at last separating

from the thin rachis on which they seem to be strung. Spikes apparently unisexual, but both sexes present on a single plant. *Flowers* free from each other; ♂ perianth obtriangular, more or less deeply split; stamen 1, anther exsert; ♀ perianth obliquely flagon-shaped, unilaterally split at the apex,  $1\frac{1}{2}$ –2 mm long. *Utricle* compressed, indurate. *Seed* erect, orbicular; testa membranous.

Distr. Coasts of tropical Africa, Hindustan, Bengal, in *Malaysia*: Java, Madura, Kangean Archipelago, Sumbawa, Sumba, Timor.

Ecol. Near the sea on salt clayey soils, which may be covered by a thin layer of sand, often more or less gregarious. Fl. Jan.–Dec.

Vern. *Kemalahala* (Sumba).

## 6. SUAEDA

FORSK. Fl. Aeg.–Arab. (1775) 69, 18.

Annual, biennial or perennial herbs, or shrubs, erect, ascending or prostrate; stems not conspicuously articulate. *Leaves* alternate, sessile, narrowly linear, terete or semiterete, succulent. *Flowers* small, ♀ or partly unisexual, sessile, clustered or higher ones solitary; clusters in the axil of a leaf or a bract, 2–∞-flowered, often united in panicle inflorescences. Flowers 2–3-bracteolate; perianth herbaceous, deeply 5-cleft; segments subequal or 2–3 outer ones swollen on the back into tubercle; rarely all of them winged. Stamens 5, on base of perianth. Ovary free or at the base adnate to the base of the perianth, globose, ovoid or flask-shaped; styles 2–5, subulate or filiform. *Fruit* enclosed by the enlarged, more or less succulent perianth; pericarp membranous or spongy. *Seed* horizontal, oblique or erect, smooth; embryo planospiral, often green.

Distr. Few spp., all over the world.

1. *Suaeda maritima* (LINNÉ) DUM. Fl. Belg. (1827) 22; BTH. Fl. Austr. 5 (1870) 206; HOOK. f. Fl. Br. Ind. 5 (1886), 14; BAILEY, Queensl. Fl. 4 (1901) 1263; KOORD. Exk. Fl. 2 (1912) 192; ASCH. & GR. Syn. 5, 1 (1913) 240; HEGI, Ill. Fl. Mitt. Eur. 3 (1912) 257; DOMIN, Beitr. Pflanzengeogr. Austr. (1929) 626; HEYNE, Nutt. Pl. (1927) 604; BACK. Onkr. Suiker. (1930) 214; Atlas t. 225; OCHSE & BAKH. v. D. BR. Veget. (1931) 105 *cum icone*.—*Chenopodium maritimum* LINNÉ, Sp. Pl. (1753) 221.—*Salsola indica* WILLD. Sp. Plant. I (1797) 1317; BL. Bijdr. (1825) 536.—*Chenopodium australe* R. BR. Prodr. (1810) 407.—*Suaeda indica* Moq. in Ann. Sc. Nat. 23 (1831) 316.—*S. australis* Moq. in Ann. Sc. Nat. 23 (1831) 318; COURCH. in LEC. Fl. Gén. I.C. 5 (1910) 8.—*Chenopodia maritima* Moq. in DC. Prodr. 13, 2 (1849) 161.—*Ch. australis* Moq. in DC. Prodr. 13, 2 (1849) 163.—*Suaeda nudiflora* Moq. in DC. Prodr. 13, 2 (1849) 155; VAL. in Bull. Dept. Agr. 10 (1907) 9; KOORD. Exk. fl. 2 (1912) 192.

Perennial glabrous herb, 7–45 cm long, at an advanced age often woody at the base, usually divided from the base into obliquely erect or ascending branches, often rooting from the lower joints; old stems tuberculate by scars of fallen leaves. *Leaves* rather crowded, linear, semiterete, with well-developed aquiferous tissue, glaucous or more or less tinged with purple or entirely purple,  $1\frac{1}{2}$ –4 cm

long, with a saltish taste. *Inflorescence* usually paniculately branched,  $2\frac{1}{2}$ –15 cm; flowers in clusters of 2–5 or highest solitary, all ♀; lower bracts rather large, foliaceous; higher ones gradually smaller; bracteoles at the base of perianth 2–3, oblong obtuse, transparent,  $\frac{2}{3}$ –1 mm long, persistent, after fall of the fruit ± stellately spreading. Perianth green of more or less suffused with purple; segments at first (♀ stage) conniving, leaving only at top a small orifice for the protrusion of the styles, afterwards (♂ stage) spreading, after anthesis once more connivent and enclosing the fruit, ovate, obtuse, with ± transparent margins and top; perianth in the ♀ stage ±  $1\frac{1}{4}$  mm diam., in the ♂ stage ±  $2\frac{1}{2}$  mm; anthers broad, bilobed at the base, ±  $\frac{1}{2}$  mm long. Ovary free from perianth, ovoid-conical; styles 2, rarely 3, rather long. *Fruiting perianth* depressed, without either tubercles or wings, in the living plant 2– $2\frac{1}{2}$  mm diam., succulent. Seed usually horizontal, rarely vertical, shining brown; albumen very scanty.

Distr. Europe, N. Africa, Asia, Australia, N. America, in *Malaysia*: West and East Java, Madura, New Guinea (?).

Ecol. Moist or swampy, clayey, saltish soils near the sea, often gregarious, frequently very conspicuous by its purple colour. Red and green specimens often grow intermixed.

Vern. *Alur*, J.

Use. Leaves sometimes eaten by the Indonesians as a vegetable.

Notes. Very polymorphous species.

The two specimens recorded as *Suaeda nudiflora*

by KOORDERS *l.c.* for the Karimon Djawa Isl. belong both to *Salsola kali*. ZOLLINGER 2909 from Banjuwangi (E. Java) is *Suaeda maritima*; ZOLLINGER (Syst. Verz. (1854) 108) could not place it.

## 7. SALSOLA

LINNÉ, Sp.Pl. (1753) 222.

Herbs or shrubs, glabrous or hairy; stems not conspicuously jointed. *Leaves* alternate or lowest opposite, sessile, linear or triangular, often spine-tipped. *Flowers* axillary, solitary or glomerate, sessile, ♀, bibracteolate at the base; bracteoles exceeding perianth. Perianth 5-partite down to the base; segments ovate-oblong, in or below the middle with a transverse thickening, above the thickening scarious, after anthesis completely embracing the fruit; the thickening after anthesis often excrecent into a horizontal wing; basal part of perianth unchanged or slightly indurate. Stamens 5, inserted on annular disk; filaments linear or subulate; anthers short or long; connective either produced into a point or not. Ovary globose-ovoid; style short or long, split into 2 long arms. *Fruit* falling off together with perianth; pericarp membranous or fleshy. Seed usually horizontal, exalbuminous; embryo coiled in a conical spire, often green.

Distr. Species  $\pm$  100, in Europe, Africa and Asia; a few introduced species in America and Australia, in *Malaysia* only the ubiquitous *S. kali* L.

1. *Salsola kali* LINNÉ, Sp.Pl. (1753) 222; MOQ. in DC. Prodr. 13, 2 (1849) 187; BTH. Fl. Austr. 5 (1870) 207; HOOK. f. Fl. Br. Ind. 5 (1886) 17; BAILEY, Queensl. Fl. 4 (1901) 1264; PULLE in Nova Guin. 8 (1910) 349; KOORD. Exk. Fl. 2 (1912) 192; ASCH. & GR., Syn. 5, 1 (1913, 1914) 207; HEGI, Ill. Fl. Mitt. Eur. 3 (1912) 258; BACK. Trop. Natuur 11 (1922) 135, tab. 2, 3.—*Salsola tragus* LINNÉ, Sp. Pl. Ed. 2 (1763) 322; DCNE in Nouv. Ann. Mus. 3 (1834) 370; SPAN. in Linnaea 15 (1841) 345.—*S. australis* R.BR. Prodr. (1810) 411; MOQ. in DC. Prodr. 13, 2 (1849) 188; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1022; FORB. Nat. Wand. (1885) 515.—*S. brachypteris* MOQ. in DC. Prodr. 13, 2 (1849) 189; ZOLL. Syst. Verz. (1854) 168 (specimen not seen); MIQ. Fl. Ind. Bat. 1, 1 (1858) 1022; FORB. Nat. Wand. (1885) 515.

Psammophilous, glabrous or slightly pubescent annual, usually branched from the base and forming dense tufts; stems erect, or prostrate beneath, often woody at the base, 30–60 cm long. Lower *leaves* of young Malaysian specimens narrowly linear, rather flaccid, 2–7½ cm long; higher leaves gradually shorter, proportionally broader; highest tapering from a broad amplexicaulous membranous-margined base, channelled, rigid, recurved, ½–1 cm long; all leaves spine-tipped, fleshy,  $\pm$  glaucous. *Flowers* solitary in axil of floral leaves, remote or in small numbers densely crowded on short axillary branchlets and then seemingly in axillary fascicles, which, when fruits are ripe, fall off as a whole; bracteoles recurved, rigid, tapering from a broad base, channelled, pungent, 4–5 mm long; perianth-segments ovate-oblong acute, 3–

3½ mm. Filaments linear; anthers short, bilobed at the base,  $\pm$  1½ mm; connective not or hardly produced. Style arms far exerted from perianth; base of fruiting perianth campanulate, pergamenous,  $\pm$  2 mm high, closely embracing the fruit; wings varying from very short to well-developed, often pink; 3 of them usually much broader than the rest, often emarginate; tips of the perianth-segments conniving above the fruit into a cone, thinly scarious. *Fruits* shortly obconical, truncate, tipped by the style-base,  $\pm$  1½ mm diam., at last circumsciss; apical part falling away. Seed horizontal, subglobose, shining black.

Distr. Europe, N. Africa, Asia, Australia, N. America, in *Malaysia*: Java (said to have been collected in 1828 by BÉLANGER; I saw no Javan specimens), Karimon Djawa Arch., Madura, Bali, Kangean Arch., Celebes, Saleier, Buton, Timor, Key Isl., New-Guinea.

Ecol. Sandy sea-shores, very local. Flowers in dry regions in the rainy season; disappears in the latter half of the dry monsoon.

Vern. Landep, J, sundepan, J.

Note. Very polymorphous plant.

TEYSMANN (in Nat. Tijds. Ned. Ind. 11 (1856) 202) records *Salsola* for the region between Surabaya and Tuban, but in a manner which suggests that he was mistaken. He says: 'The road crosses coastal swamps in which grow *Rhizophora*, *Avicennia*, *Salsola*, *Trianthema* and other marsh-plants.' As a matter of fact, *Salsola* never grows in marshes; TEYSMANN, whose knowledge of plants was ample but superficial, may have confounded it with *Suaeda*.

## PLUMBAGINACEAE (C. G. G. J. van Steenis, Buitenzorg)

BOISS. in DC. Prod. 12 (1848) 617; MIQ. Fl. Ind. Bat. 2 (1859) 993; B. & H. Gen. Pl. 2 (1876) 623; CLARKE, in HOOK. f. Fl. Br. Ind. 3 (1882) 478; BENTH. Fl. Austr. 4 (1869) 265; PAX, in E. & P. 4, 1 (1889) 116; BOERL. Handl. 2, 1 (1891) 274; BAILL. Hist. Pl. 11 (1892) 359; BAIL. Queensl. Fl. (1900) 943; GAMBLE, J. As. Soc. Beng. 74, II (1906) 84; RIDL. Fl. Mal. Pen. 2 (1923) 224; SPRAGUE, J. Bot. 62 (1924) 267; GAMS, in HEGI, Ill. Fl. Mitt. Eur. 5, 3 (1926) 1877; HUTCH. Fam. Fl. Pl. 1 (1926) 290; BACKER, Onkruidfl. Jav. Suik. (1931) 477.

Herbs or undershrubs. *Leaves* simple. Stipules absent. *Flowers* bisexual, actinomorphic, often in unilateral inflorescences, or subumbellate. Bracts often sheathing, dry and membranous. Bracteoles 2. Calyx tubular, gamosepalous, often conspicuously ribbed, folded, the membranous folds often hyaline, lobes 5, often scarious. *Petals* free, but mostly connate at the base, contorted. Disk 0. Stamens 5, epipetalous, and connate with their base. Anthers 2-celled, opening lengthwise. Ovary superior, mostly sessile, often angled, 1-celled with 1 ovule pendulous from a basal funicle; styles 5, free or variously connate; stigma subcapitate. *Capsule* membranous, mostly included, circumscissile near the thin base, rarely valvate from the base upwards. Seed 1, with or without endosperm, cylindric.

Distr. Throughout the world, ca 10 genera.

Ecol. Mostly in salty steppes, or littoral. Leaves variously reduced to needle-shape, often provided with glands secreting water, mucus, salts or CaCO<sub>3</sub>.

Uses. Several species are medicinal; see *Plumbago*.

### KEY TO THE GENERA

1. Leaves scattered or alternate on the stems, not rosulate.
  3. Petiole alate throughout, clasping the branch. Blade orbicular . . . . . 1. *Aegialites*
  3. Petiole not so. Blade not orbicular . . . . . 2. *Plumbago*
1. Scapose herbs. Leaves rosulate. Rootstock.
  2. Flowers in heads. Scape unbranched. Leaves 1-nerved. . . . . 3. *Armeria*
  2. Flowers in wide-branched corymbs, unilateral, spicate. Leaves large, pinnatisect-spathulate . . . . . 4. *Limonium*

### 1. AEGIALITES

R.BR. Prod. (1810) 426 (not of TRIN. 1820); ROXB. Fl. Ind. 2 (1832) 111 (*Aegelatis*); BOISS. l.c. 621; GRIFF. Not. 4 (1854) 207 (*Aegiatilis*); MIQ. l.c. 994; B. & H. l.c. 624; KURZ, J. As. Soc. Beng. 46, II (1877) 217; For. Fl. Burma 2 (1877) 96; CLARKE, l.c. (*Aegianilites*); BOERL. l.c. 278; PAX l.c.; BAILL. l.c.; GAMBLE l.c.—*Aegialinites* PRESL, Bot. Bem. (1844) 103.

Simple-stemmed shrub, or undershrubs,  $\frac{1}{3}$ –3 m tall, branches with pith. *Leaves* alternate, orbicular, glabrous, coriaceous, entire, smooth, gland-dotted; nerves and veins parallel; petiole long, thick, winged, clasping the stem, leaving annular scars, glandular inside. *Flowers* solitary in the axil of a bract, erect, in leafy panicles often fork-branched racemes not much exceeding the leaves. Bracts sheathing, enclosing 2 similar but smaller boat-shaped bracteoles, all persistent, glandular inside. Calyx persistent, wholly or only upwards with 5 prominent ribs, folded between, tubular, lobes short. *Corolla* white, longer than the calyx, easily detached circumscissile at the base, lobes elongate-spathulate, subconcave 3-nerved, mutually connate at the base in a short tube together with the stamens; tube annular or barrel-shaped, after anthesis when pushed out splitting upwards from the base.

Stamens inserted on the apex of the tube, anthers basifix *c.* as long as the corolla, sagittate at the base; cells  $\pm$  parallel, halfway free, latrorse; connective a narrow furrow between the cells; pollen 90–120  $\mu$  diam. Styles free, articulate at the base; stigma small, punctiform-capitate, reaching just above the stamens. *Capsule* linear, long-exserted, pentagonal, dehiscing finally along the angles.

Distr. 2 spp., SE. Asia to Australia, absent in many districts of *Malaysia* (fig. 1).

Ecol. In the open mangrove, according to TEYSMANN and BRASS also on rocky beaches and exposed shorelines, on sandy soil (WARBURG), locally in small pure groves. The stembase in *Ae. rotundifolia* is said to be swollen and conical (GRIFFITH, CRAIB, BRANDIS). Aerophores are not found (WARBURG). GRIFFITH says that the petioles, bracts, and bracteoles exude a viscosc fluid. This is due to mucilaginous glands which are widely distributed in the family (*cf.* WILSON, Ann. Bot. 4 (1890) 244). In the Ceram specimens I found sand adhering to calyx and corolla. The exocarp is coriaceous; the mesocarp is swollen and spongy and contains air in the herbarium; the endocarp is thin. The mesocarp therefore seems to contribute the means by which the fruit can drift. The elongated fruit reminds of viviparous *Rhizophoraceae*, *Aegiceras*, &c. The flowers seem not to be ephemeral; therefore measurements of the ovary (proportion length/diameter) are not constant, as it enlarges during anthesis. The corolla is after anthesis circumscissile at the base and is slowly pushed out, and its basal obconical part enclosing the ovary is partly slit upwards. Field study is urgently needed to clear the life-history and variability of this peculiar genus.

Notes. The genus consists of two widely separated populations which show rather unimportant differences in the flower. As no intermediates are known and the ecological behaviour is different I accept them provisionally as two distinct species. The disjunction is similar to that in *Aldrovanda*, *Philydrum lanuginosum*, &c; the absence in the intervening area is unexplained.

#### KEY TO THE SPECIES

1. Leaves shining above, reticulations prominent *s.s.* Flowering parts larger than in next species, longer pedicelled. Calyx 13 mm, lobes hardly imbricating, acute-triangular. Corolla tube ( $3\frac{1}{2}$ –)5 mm high, lobes 12 by 3–4 mm below the apex. Anthers 3 mm; filament inserted in the middle. Ovary 5–10 by  $2\frac{1}{2}$ –5 mm, little acuminate towards the apex . . . . . 2. *Ae. rotundifolia*
1. Leaves dull above, reticulations indistinct *s.s.* Flowering parts smaller than in the prec. species. Flower sessile or up to 5 mm pedicelled. Calyx 7–8 mm, lobes distinctly imbricating, their apex rounded to subtruncate, mucronulate. Corolla tube 1–2 mm high, lobes 9–10 by  $1\frac{1}{2}$ –2 mm. Anthers 2 mm long, filament inserted at  $\frac{1}{3}$  of the length. Ovary 3–4 by  $1\frac{1}{2}$ –2 mm, oval . . . . . 1. *Ae. annulata*

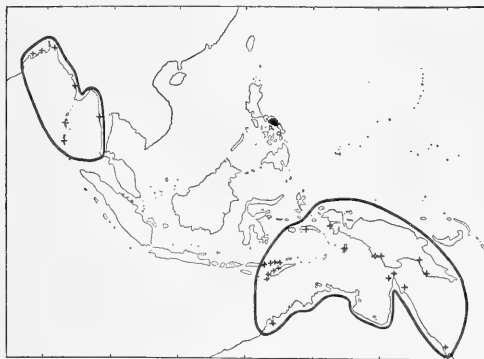


Fig. 1. Distribution of *Aegialites*.

1. *Aegialites annulata* R.Br. Prod. 1 (1810) 426; GAUD. in FREYCH. Voy. (1826) t. 51; BOISS. in DC Prod. 12 (1848) 621; MIQ. Fl. Ind. Bat. 2 (1859) 995; BENTH. Fl. Austr. 4 (1869) 266; TEYSM. Nat. Tijd. N.I. 34 (1874) 456; HEMS. Rep. Chall. Bot. pt 3 (1884) 161; WARB. Bot. Jahrb. 13 (1891) 400; BAILL. Hist. Pl. 11 (1892) 359; BAIL. Queensl. Fl. (1900) 943; PULLE, Nova Guinea 8 (1910) 397; BAIL. Compr. Cat. Q. Pl. (1913) pl. 298; WHITE, J. Arn. Arb. 10 (1929) 258.—*Aegianilites annulata* PRESL, Bot. Bem. (1844) 103.

Stembase swollen, conical. *Leaves* rotundate to oval, 4–8 by  $2\frac{1}{2}$ –7 cm. Petiole  $3\frac{1}{2}$ –8 cm long. Bracts 7–9 by 6 mm, bracteoles 6–8 by 2 mm. *Flowers* sessile or up to 5 mm pedicelled. Stamens 7–8 mm. Styles 6–7 mm. *Fruit* 2 mm diam., first straight, gradually elongating, later falcate up to 5 cm long, but not thickening.

Distr. Queensland, NW. Australia, Thursday Isl. and E. *Malaysia*: S. New Guinea, Moluccas (Aru, Ceram) and Lesser Sunda Isl. (Timor, Semaui, Alor, Adonara, E. Flores (Larantuka)).—Fig. 1.

Ecol. BRASS's Papuan specimens were only 30–45 cm tall. Grows in isolated specimens or small colonies in more sandy and rocky places than the following species.

2. *Aegialites rotundifolia* ROXB. Fl. Ind. 2 (1832) 111 (*Aegelatis*); GRIFF. Not. 4 (1854) 207, t. 461, f. 2; PRAIN, Beng. Pl. 1 (1903) 638; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1882) 479; BRANDIS, Ind. Trees (1906) 413; GAMBLE, J. As. Soc. Beng. 74, II (1906) 85; RIDL. Fl. Mal. Pen. 2 (1923) 225; CRAIB, Fl. Siam 2 (1938) 320.—*Aegianilites rotundifolia* PRESL, Bot. Bem. (1844) 103; GRIFF. Ic. pl. As. (1854) t. 654.—*Ae. annulata* var. *rotundifolia* BOISS. in DC. Prod. 12 (1848) 621; KURZ, J. As. Soc. Beng. 46, II (1877) 217; For. Fl. Burma 2 (1877) 96.

*Leaves* orbicular, base mostly rounded or broad-

cuneate to slightly cordate, apex truncate or slightly obtuse, protruding,  $4\frac{1}{2}$ –7 cm diam. Petiole 5–7½ cm long. Bract 10–11 mm. Bracteoles 8–9 mm. *Flowers* pedicelled up to 13 mm. Stamens 13–18 mm. Styles 9–10 mm. Ripe *fruit* not described.

Distr. Bengal, Burma, Siam, Mergui, Tenasserim, Andaman Isl., according to RIDLEY erroneously recorded for the Malay Peninsula, but likely to occur there somewhere or in N. Sumatra.—**Fig. 1.**  
Ecol. Low muddy mangrove.

## 2. PLUMBAGO

LINNÉ, Sp. Pl. 1 (1753) 151; *cf.* lit. under family; STEEN. Trop. Natuur 26 (1937) 12.

Perennial herbs or undershrubs, rarely annual, often straggling or subscandent. *Leaves* spread, entire, older ones often below pale-lepidote by excreted carbonates, or reduced on the flowering stems; petiole often semi-amplexicaulous-auriculate at the base. *Flowers* in terminal racemes or spikes, often united in a leafy panicle, blue, rosa, white or violet, ephemeral, not caducous. Calyx tubular, outside often with sessile or stalked glands, teeth erect, not enlarged in fruit. Corolla funnel-shaped, lobes spreading. Stamens free, broadened at the base. Style short, with 5 branches. *Capsule* included in the persistent calyx and (often twisted) corolla; pericarp thin, hardened above, circumscissile near the base, caducous part often splitting towards the apex with 5 valves.

Distr. About 10 *spp.* in all tropics, often used as ornamentals.

Ecol. Not limited to saline localities, but preferably under semi-arid conditions. Of *P. indica* no fruit has ever been found, and *P. aphylla* and *P. auriculata* never produce fruit in Java; they are propagated vegetatively. The leaves of the latter are often covered below with greyish scales of excreted CaCO<sub>3</sub>.

Uses. *Plumbago*, leadwort, derives its name from the colour adapted by the skin after the medicinal use of the European *Pl. europaea*, a plant used in historic time for curing *plumbum*, an illness of the eyes. The Indian species too are often used medicinally. The active substance, plumbagin, is known as a narcotic and specially as a vesicatory and anthelmintic. It is specially extracted from the roots; *radix vesicatoria* was already figured by RUMPHIUS, Herb. Amb. 5, p. 453, t. 168 (*P. indica*). Several *spp.* are known as ornamentals, mostly *P. auriculata*. In a strict sense none is native in Malaysia, though *P. zeylanica* might be accepted as such.

### KEY TO THE SPECIES

1. Corolla white, tube less than 2½ cm long, limb 12–15 mm diam. Rachis of the raceme or spike with sessile or stalked glands.
2. Leaves well-developed on flowering stems, 3–12½ by 2–5 cm. Rachis with sessile glands
  1. *Pl. zeylanica*
2. Leaves mostly only present on young stems, ½–1½ cm long, absent on flowering stems. Rachis with stalked glands
  2. *Pl. aphylla*
1. Corolla red or blue, tube 2½–4 cm long, limb 2–3 cm diam. Rachis hairy or glabrous but without glands.
3. Corolla light blue, lobes without a distinct mucro. Calyx greenish-yellow, 10–14 mm long, lower ⅓–⅔ part without glands, finely but short-hairy
  3. *Pl. auriculata*
3. Corolla red, lobes distinctly mucronate. Calyx red, 8–9 mm long, glandular all over, glabrous
  4. *Pl. indica*

1. *Plumbago zeylanica* LINNÉ, Sp. Pl. (1753) 151, *cf.* lit. under family; BENTH. Fl. Austr. 4 (1869) 267; MERR. Fl. Man. (1912) 362; Sp. Blanc. (1918) 300; En. Philip. 3 (1923) 275; HEYNE, Nutt. Pl. (1927) 1222; MERR. Comm. Lour. (1935) 301; BACKER, Bekn. Fl. Jav. 8 (1949) fam 181, p. 2.—*Pl. auriculata* (non LAMK) Bl. Bijdr. 14 (1826) 736.—*P. viscosa* BLANCO, Fl. Filip. (1837) 78; ed. 2 (1845) 58; ed. 3, 1 (1877) 111.

Straggling shrub. Twigs long, not rooting, 1½–2½ m. Young *leaves* with caducous small auricles. Racemes 6–30 cm, glands green often red-tipped. Calyx glabrous, glandular all over, green. *Corolla* tube 18–22 mm, lobes obovate 6–7 mm. Anthers blue-purple. Ovary and style glabrous. *Fruit* oblong, acute with 5 furrows, calyx patent and recurved.

Distr. Tropics of the Old World to Hawaii,

possibly only indigenous in SE. Asia, in *Malaysia*: not yet found in Borneo and the Moluccas, also cultivated.

Ecol. Both under feeble and strong dry-season conditions, preferably in the latter, always in anthropogenic localities, savannahs, thickets, &c, up to 1000 m, fl. Jan.–Dec.

Vern. *Bama*, *bantji*, *poksor*, *godong èntjok*, *J*, *karèka*, *Md*, *ki èntjok*, *Sd*, *daun èntjok*, *M*, *bama* (Bali), *oporio* (Timor), *jarak*, *cheraka* (Mal. Pen.); Philippines: *bangbang*, *Ilk.*, *sangdikit*, *Tag.*, *talankan*, *Ilk.*

2. *Plumbago aphylla* BOJER *ex* BOISS. in DC. Prod. 12 (1848) 694; PAX in E. & P. 4, 1 (1889) 117; STEEN. Trop. Natuur 26 (1937) 13; BACKER, Bekn. Fl. Jav. 8 (1949) fam. 181, p. 2.

Strong taproot producing few-branched, rather



Fig. 2. *Plumbago indica* L.,  $\times \frac{1}{2}$ . (Courtesy Pasuruan Exp. Station)

straight, rod-shaped stems  $1/2$ –1 m long, often rooting and producing new plants. *Leaves* without auricles. Racemes 2–6 cm long. Calyx 7–8 mm high, hairy between the glands. *Corolla*-tube 14–16 mm, much broader than in the prec. *sp.*, lobes emarginate. Anthers green-yellow. Style base long-hairy.

Distr. Indigenous in Madagascar, in *Java* sometimes in gardens but not very recommendable as an ornamental; no fruit is produced in Malaysia. *Fl.* Jan.–Dec.

**3. *Plumbago auriculata* LAMK.** *Encycl.* 2 (1876) 270; MERR. *Fl. Man.* (1912) 361; EN. Philip. 3 (1923) 275, non BL. (1825).—*P. capensis* THUNB. *Prod. Fl. Cap.* (1794) 33; DC. *Prod.* 12 (1848) 693; NAVES in BLANCO, *Fl. Filip.* ed. 3 (1877) 83, t. 27; F.-VILL. *Nov. App.* (1880) 122; STEEN. *Trop. Natuur* 26 (1937) 13; BACKER, *Bekn. Fl. Jav.* 8 (1949) fam. 181, p. 2.

Erect shrub or halfshrub,  $1/3$ – $1 1/2$  m. *Leaves* oblong to obovate,  $1 1/2$ –5 by  $3/4$ –2 cm, auricles mostly large. Upper axils with a bundle of leaves. Racemes mostly combined to leafy corymbs; rachis 1–6 cm long, densely puberulous. *Calyx* green, 10–14 mm long, lower  $1/3$ – $2/3$  puberulous but without glands. Ovary pear-shaped, style base glabrous.

Distr. Native of S. Africa, in *Malaysia*: a common ornamental, up to 1100 m, does not run wild. *Fl.* Jan.–Dec.

Vern. *Mannentrouw*, *verliefde luitenantjes* (Dutch).

**4. *Plumbago indica* LINNÉ** in STICKM. *Herb. Amb.* (1754) 24; AMOEN. *Acad.* 4 (1759) 133; HORSEF. *Verh. Bat. Gen.* 8 (1816) 108; MERR. *Int. Rumph.* (1917) 414; EN. Philip. 3 (1923) 275; HEYNE, *Nutt. Pl.* (1927) 1221; BACKER, *Onkruidfl. Suik.* (1931)

478; STEEN. *Trop. Natuur* 26 (1937) 13; BACKER, *Bekn. Fl. Jav.* 8 (1949) fam. 181, p. 3.—*Radix vesicatoria* RUMPH. *Herb. Amb.* 4 (1750) 453, t. 168 (type).—*Pl. rosea* LINNÉ, *Sp. Pl.* ed. 2 (1762) 215; BURKILL, *Dict.* (1935) 1774; MIQ. *Fl. Ind. Bat.* 2 (1859) 993; CLARKE in HOOK. *f. Fl. Br. Ind.* 3 (1882) 481; GRESH. *Schets.* 210; MERR. *Fl. Man.* (1912) 362; PELLEGRIN, *Fl. Gén. I.C.* 3 (1930) 752; RIDL. *Fl. Mal. Pen.* 2 (1923) 225.—*Pl. coccinea* (LOUR.) SALISB. *Prod.* (1796) 122.—**Fig. 2.**

Branched from the base, stems flaccid, sometimes rooting,  $1/2$ – $1 1/2$  m. *Leaves* oblong, 5–15 by 2–8 cm, without fascicled leaves in the axils, petiole not auriculate. *Calyx* red, 8–9 mm high, glabrous, glandular all over. Racemes not corymbiform, rather sparse. Rachis glabrous, 10–30 cm long. Ovary ovate-oblong. Style base short-hairy. *Fruit* unknown.

Distr. Widely distributed in the Old World tropics, probably native in SE. Asia, certainly not a sport or variety of *Pl. zeylanica*, in *Malaysia*: not yet recorded from the Malay Peninsula, Borneo, and New Guinea, ascending to 1000 m, also cultivated.

Ecol. Always in anthropogenic localities, locally run wild or semi-spontaneous, often persistent in abandoned cultivations, also in teak-forests, *fl.* Jan.–Dec.

Uses. Ornamental, sometimes medicinal as a substitute for *Rauwolfia serpentina* BTH.

Vern. *Poelè pandak* (Ialaki), *tjeraka merah*, *akar binasa*, M., *bama*, J., *daun srunen*, Md., *vuurwortel*, Dutch, *akar binasa*, Mol., *setaka*, Mol., *mehulatoe*, Amb., *auwarian*, Banda, *mehutana hane*, Mol., *nehulatu*, Mol.; Philippines: *laurel*, Bik., Sp., Tag., *panting panting*, Mag., *sutungau*, Tagb., *ulanda*, Sul.

### 3. ARMERIA

WILLD. *En. Hort. Berol.* 1 (1809) 333, *nom.cons.*—*Statice* L. *p.p.*

Perennial tufted scapose herbs with narrow rosulate *leaves* and a subterraneous, branched rootstock. *Flowers* in heads subtended by dry bracts, bases of the outer ones coalescent into a tubular sheath. Calyx obconical, 5-lobed, lobes mucronate. Petals united at the base. Stamens inserted on top of the tube. Style  $\pm$  free, stigma cylindric. *Fruit* circumscissile at the base.

Distr. *Spp.* 10 or 60 depending on the specific concept, cosmopolitan, not native in Australia and *Malaysia*.

**1. *Armeria maritima* (MILL.) WILLD.** *L.c.*—*Statice armeria* LINNÉ, *Sp. Pl.* (1753) 274.—*Statice maritima* MILL. *Gard. Dict.* ed. 8 (1768) no 3.—*Armeria vulgaris* WILLD. *L.c.*—*Statice armeria* var. *maritima* (MILL.) GAMS, in HEGI, *Ill. Fl. Mitt. Eur.* 5, 3 (1926) 1888; BACKER, *Bekn. Fl. Jav.* 8 (1949) fam. 181, p. 3.

*Leaves* 1-nerved, slightly puberulous on margins

and midrib, 5–7 by 1 mm. Culms 10–20 cm, thin and hard, puberulous, apex hollow. Heads 2–2 $3/4$  cm diam., sheath 10–18 mm. Calyx 6 mm high. *Petals* cuneate-spathulate, emarginate, rose to red, their base pale, rarely white, 8–10 mm long. Style bases hairy.

Distr. Native of Europe, sometimes cultivated in the mountains of *Java* (acc. to BACKER), *fl.* Aug.



## 4. LIMONIUM

MILL. Gard. Dict. Abridg. ed. 4 (1754); ADANS. Fam. 2 (1763) 283; DRUCE, Rep. Bot. Exch. Club Br. Isl. (1913) III, 433.—*Statice* L. em. WILLD. non MILL.

Stiff, erect herbs. *Leaves* rosulate, spatulate, entire or lobed, often large. *Flowers* in widely branched corymbs, consisting of unilateral spikes. Bracteoles unequal. Calyx tube narrow, 5-ribbed; limb scarious, coloured, teeth often mucronate. Petals mostly  $\pm$  free, at the base connate with the stamens. Styles  $\pm$  free, stigma cylindric, rarely (§ *Goniolimon*) capitate. *Fruit* indehiscent or capsular at the apex.

Distr. More than 100 spp., cosmopolitan, not native in *Malaysia*. This absence is surprising as the genus occurs both in Australia and Asia. This distributional discontinuity is found in several plants, e.g. *Philydrum lanuginosum*, *Rothia trifoliata*, *Samolus valerandi*, &c. Some of the plants of this type have occasionally been found in *Malaysia*, e.g. *Eriocaulon setaceum*, *Hydrocotyle peltata*, *Aldrovanda vesiculosa*, *Montia*, *Anagallis pumila*, but remain exceedingly scarce.

**1. *Limonium sinuatum* (L.) MILL.** Gard. Dict. ed. 8 (1768) no 6; GAMS in HEGI, Ill. Fl. Mitt. Eur. 5, 3 (1926) 1881; BACKER, Bekn. Fl. Jav. 8 (1949) fam. 181, p. 4.—*Statice sinuata* LINNÉ, Sp.Pl. (1753) 276; CURT. Bot. Mag. t. 71; BOISS. in DC. Prodr. 12 (1848) 635.

Robust,  $\frac{1}{2}$ –1 m. *Leaves* lanceolate-spatulate, deeply pinnatisect, 20–50 by  $2\frac{1}{2}$ –6 cm (incl. the long petiole), sparsely long-hairy. Peduncle and branches distinctly winged, wings  $\pm$  crisped, on

each fork with 3 erect, leafy, linear, 1–12 mm long appendages. Unilateral *spikes* dense, stalk between the bracts 3-alate, one wing narrow, the others broadening. Large bracteole folded, short-3-lobed, apex on the back with 2–3 teeth, narrow bracteole needle-tipped. Calyx tube 6 mm long, limb entire, fine-plaited, blue, white or rosa, 6–7 mm long.

Distr. Native of the Mediterranean, sometimes ornamental in the mountains of Java (acc. to BACKER), fl. July, Nov.

## Excluded

*Limonium billardieri* (GIRARD) O.K. Rev. Gen. (1891) 394.—*Statice billardieri* GIRARD, Ann. Sc. Nat. III, 2 (1844) 325; BOISS. in DC. Prodr. 12 (1848) 658; MIQ. Fl. Ind. Bat. 2 (1859) 995; HAL-LIER f. in ELBERT, Sunda Exp. 2 (1912) 294; KOORD. Exk. Fl. Java 3 (1912) 36 (*sic*).

This species was based on a specimen said to have been collected by LA BILLARDIÈRE in Buru Island (Moluccas) on the expedition of 'La Recherche et l'Espérance' which went along the Cape Verde's to Cape of Good Hope, Australia and Me-anesia to the Moluccas, and stayed in Buru from

Sept. 18–30 at Kajeli, the principal harbour. A co-type kindly sent by Dr BAEHNI agrees with BURCHELL 512 at Leyden and is identified as *L. equisetinum* (BOISS.) DYER var. *depauperatum* (BOISS.) from the Cape. There are one developed flower and one reduced flower in each spikelet. It is closely allied to *L. scabrum* (THUNB.) O.K. The occurrence of minute tufts of hairs on the scape is typical. Cf. also WRIGHT, in Fl. Cap. 4, 1 (1909) 422. This is the 2nd instance in which a species of this genus was mislabelled (*cf.* Kew Bull. 1948, 368).

## UMBELLIFERAE († P. Buwalda, Groningen)

Annual or perennial herbs, never woody shrubs (in Malaysia). Stems often furrowed and with soft pith. *Leaves* alternate along the stems, often also in rosettes; petiole usually with a sheath, sometimes with stipules at the base; lamina usually much divided, sometimes entire. *Flowers* polygamous, in simple or compound umbels, sometimes in heads, terminal or leaf-opposed, beneath with or without involucre and involucel. Calyx teeth 5, often obsolete. *Petals* 5, alternate with the calyx teeth, equal or outer ones of the inflorescence enlarged, entire or more or less divided, often with inflexed tips, inserted below the epigynous disk. Stamens alternate with the petals, similarly inserted. Disk 2-lobed, free from the styles or confluent with their thickened base, forming a stylopodium. Ovary inferior; styles 2. *Fruits* with 2 one-seeded mericarps, connected by a narrow or broad junction (*commissure*) in fruit separating, leaving sometimes a persistent axis (*carpopophore*) either entire or splitting into 2 halves; mericarps with 5 longitudinal ribs, 1 dorsal rib at the back of the mericarp, 2 lateral ribs at the commissure; 2 intermediate ribs between the dorsal and the lateral ones; sometimes with secondary ribs between the primary ones, these without fascicular bundles; often vittae in the ridges between the ribs or under the secondary ribs, and in the commissure, seldom under the primary ribs.

**Distr.** Numerous genera and species, all over the world. The representatives native in Malaysia belong geographically to five types. (1) Ubiquitous genera (*Hydrocotyle*, *Centella*, *Oenanthe*); one species, *Hydrocotyle vulgaris*, shows a remarkable disjunction, occurring in Europe & N. Africa and also in New Guinea, Australia and the Marshall Islands. (2) Western elements are *Sanicula* (wide-spread in the N. hemisphere but absent from New Guinea and Australia), *Heracleum* and *Pimpinella*; though some *spp.* are endemic their close relatives are found in SE. Asia. (3) A distinctly N. element is the Japano-Formosan *Peucedanum japonicum* in the islands N. of Luzon. (4) A distinct Australian element is *Trachymene* which centers in Australia and occurs also in New Caledonia and Fiji; this genus shows a relatively rich secondary centre in East Malaysia; another Australian alliance is found in ubiquitous *Eryngium* of which the only native Malaysian species hitherto known is allied to Australian *spp.* (5) A distinct Subantarctic-distributed genus is *Oreomyrrhis* which centers in New Guinea by 4 *spp.*; one of these occurs from Kinabalu to Australia, New Zealand to Andine South America as far as Mexico; a marked instance of the ancient alpine-Papuan South Pacific plant refuge (v. St.).

**Ecol.** As to altitude both the cultivated and native *spp.* prefer microtherm localities: *Pimpinella*, *Trachymene*, *Heracleum*, *Oreomyrrhis*, *Eryngium*, and *Hydrocotyle vulgaris* are confined to the montane or subalpine zones, *Sanicula* descending to the colline subzone. Some *Umbelliferae* are found in the alpine zone above 4000 m alt., e.g. *Hydrocotyle sibthorpioides*, and *Oreomyrrhis andicola*. Several oreophytes show a remarkable reduction of the leaf surface, and some are reduced to cushions (*Oreomyrrhis andicola*) or true pin-cushions (*Trachymene pulvilliforma* and *Oreomyrrhis azorellacea*). There are only very few *spp.* preferring a shaded locality, e.g. *Sanicula europaea*, *Hydrocotyle javanica*, *Trachymene erodioides*, ? *Heracleum sumatranum*. *Pimpinella javana* and *P. pruatjan* are often found in *Casuarina* forests. *Oenanthe javanica*, *Centella*, and the *Hydrocotyles* decidedly prefer moist or marshy places. In the semi-arid regions of Malaysia *Umbelliferae* are exceedingly scarce; *Hydrocotyle javanica* is a typical indicator for everwet conditions. Many *spp.* show a remarkable adaptive capacity to wide altitudinal limits, e.g. *Hydrocotyle sibthorpioides* 1–4050 m, *H. javanica* 1–2900 m, *Oenanthe javanica* 1–2800 m, *Centella asiatica* 1–2500 m, *Sanicula europaea* 500–3060 m (v. St.).

**Uses.** Quite a number of *Umbelliferae* are cultivated for the essential oil contained in their fruit and are used as condiments. The leaves of some *spp.* are eaten as vegetables or for medicinal purposes. Under the several species data are mentioned drafted from HEYNE, *De Nuttige Planten* ed. 2 (1927), OCHSE & BAKHUIZEN VAN DEN BRINK, *Indische Groenten* (1931) and BURKILL, *A dictionary of the economic products of the Malay Peninsula* (1935).

**Notes.** The extensive treatment in my former revision (Blumea 2, 1936) is mostly followed; several novelties are added. Of the genera which are represented only by introduced or cultivated *spp.* generic characters are not given.

When collecting *Umbelliferae* it is to be observed that ripe fruits and basal leaves are essential for identification.

**PS.** The MS. of the present revision was made before the author received the rich New Guinean collections of L. J. BRASS, M. S. CLEMENS, C. E. CARR; on the latter he prepared a separate paper to be

published in the Journal of the Arnold Arboretum which he finished just before his sudden and lamented death (cf. Bull. Bot. Gard. Btzig III, 17 (1948) 377). I am responsible for fitting the new data to the original MS. as well as for the description of *Peucedanum* (v. St.).

Figures 1 & 5 courtesy Pasuruan Exp. Station, fig. 2-4, 6 & 10 courtesy Blumea.

## KEY TO THE GENERA

1. Flowers in simple umbels<sup>1</sup> or heads often united in more compound inflorescences, but not in compound umbels.
  2. Leaves and involucre prickly. Flowers in heads . . . . . **5. Eryngium**
  2. Leaves and involucre not prickly. Flowers in umbels.
    3. Fruits with uncinat bristles . . . . . **4. Sanicula**
    3. Fruits without uncinat bristles.
      4. Fruit at least twice as long as broad; generally not laterally flattened . . . . . **9. Oreomyrrhis**
      4. Fruit not longer than broad, laterally flattened.
        - ~ 5. Mericarps 7-9-ribbed, with connecting veins between the ribs. Leaves simple, crenate, reniformous . . . . . **2. Centella**
        5. Mericarps 3-ribbed. Leaves otherwise.
          6. Leaves without sheaths but with distinct entire stipules. Corolla valvate . . . . . **1. Hydrocotyle**
          6. Leaves with sheaths, with or without lacerate stipule-like appendages. Corolla imbricate . . . . . **2. Trachymene**
  1. Flowers in compound umbels which are sometimes united in more compound inflorescences.
    7. Mericarps winged on the margin.
      8. Fruit not strongly dorsally flattened, more than twice as long as broad. Leaves tripinnate, ultimate segments nearly filiform . . . . . **19. Anethum<sup>2</sup>**
      8. Fruit strongly dorsally flattened, at most twice as long as broad. Leaves pinnate to bipinnate, extreme segments not filiform.
        9. Leaflets or ultimate leaf-segments cuneate-obovate, only dentate or incised at the broadened apex. Mericarps about twice as long as broad . . . . . **22. Peucedanum**
        9. Leaflets or ultimate leaf-segments not cuneate-obovate, margin serrate or crenate. Mericarps at most 1 1/2 times as long as broad.
          10. Ovary hairy. Involucels 6-7. Wing of the mericarps 2 1/2 mm broad. Corolla white or reddish, radiating . . . . . **21. Heracleum**
          10. Ovary glabrous. Involucels 0-2. Wing of the mericarps 1 1/4-1 1/2 mm broad. Corolla yellow, not radiating . . . . . **20. Pastinaca**
      7. Mericarps not winged at the margin.
        11. Fruit laterally flattened. Leaves simple, roundish . . . . . **1. Hydrocotyle**
        11. Fruit not laterally flattened. Leaves usually compound.
          12. Fruit with a sterile neck or a short beak visible on the ovary as a dark green ribbed neck . . . . . **6. Chaerifolium**
          12. Fruit without a sterile neck or beak.
            13. Calyx teeth distinct.
              14. Ovary and fruit bristly.
                15. Fruit with uncinat bristles; stems and leaves hairy; leaf-segments not very narrow; flowers not radiating . . . . . **7. Torilis**
                15. Fruit with stellate hairs; stems and leaves glabrous; extreme leaf-segments linear to filiform; flowers radiating . . . . . **10. Cuminum**
              14. Ovary and fruit entirely glabrous.
                16. Mericarps hollow at the ventral side; primary ribs visible as undulate lines, secondary ribs somewhat more prominent; flowers radiating . . . . . **8. Coriandrum**
                16. Mericarps not hollow at the ventral side; marginal ribs thicker than the lateral ones, secondary ribs absent; flowers not radiating . . . . . **17. Oenanthe**
            13. Calyx teeth not distinct.
              17. Ovary and fruit entirely glabrous.
                18. Leaves ternate; umbels and umbellules few-rayed. . . . . **14. Cryptotaenia**
                18. Leaves pinnate or bipinnate.
                  19. Flowers yellow or yellowish green.
                    20. Involucels many-leaved; leaves 3-4-pinnate with  $\pm$  filiform segments . . . . . **18. Foeniculum<sup>2</sup>**
                    20. Involucels 0-2-leaved; lower leaves 3-pinnate with nearly obovate or cuneate leaflets . . . . . **19. Petroselinum**

(1) Rarely solitary (1-flowered umbels).

(2) *Foeniculum* and *Anethum* are very alike with the exception of their fruits, which in *Anethum* are very distinctly winged, in *Foeniculum* not. They may further be distinguished, besides by their characteristic odor, by fine-punctulate stems in *Foeniculum* which are absent in *Anethum*.

21. Ripe fruits  $1\frac{1}{2}$ –2 mm through, roundish when seen from the lateral side; carpophore entire or very shortly bifid at the apex . . . . . 11. *Apium*  
 21. Ripe fruits 4–5 mm long and half as broad; carpophore bifid to nearly  $\frac{2}{3}$  of its length . . . . . 15. *Carum*  
 17. Ovary and fruits bristly, hairy, or with scale-like trichomes. . . . . 23. *Daucus*  
 22. Involucres pinnatifid . . . . . 23. *Daucus*  
 22. Involucres not pinnatifid. . . . . 16. *Pimpinella*  
 23. Leaves simple, or pinnate with simple leaflets; leaves and stems hairy . . . . . 16. *Pimpinella*  
 23. Leaves pinnate with divided leaflets; leaves and stems glabrous . . . . . 13. *Trachyspermum*

## 1. HYDROCOTYLE

LINNÉ, Sp.Pl. 1 (1753) 234; BUW. Blumea 2 (1936) 122 (*lit.*).

Perennial, stems prostrate or rooting at the nodes, sometimes suberect. *Leaves* petiolate and stipulate, in outline rhomboid, peltate or cordate, palminerved, entire, lobed or divided, crenate to crenate-serrate. *Umbels* simple, sometimes irregularly subcompound. Involucral bracts few or 0. Calyx teeth minute or obsolete. *Petals* entire, valvate in bud. Disk plane, margin elevated. Styles from the base filiformous or with thickened base. *Fruit* laterally flattened, commissure narrow; vittae 0; mericarps with dorsal ribs, marginate, lateral ribs in the commissure, intermediate ones straight or arcuate.

Distr. About 100 spp. all over the world, mainly in the S. hemisphere.

## KEY TO THE SPECIES

1. Leaves peltate . . . . . 3. *H. vulgaris*  
 1. Leaves not peltate.  
 2. Leaves usually less than 3 cm in diam. Stems creeping, sometimes with ascending extremities. Inflorescences single, sessile or short-peduncled, along the creeping stems and the ascending tips. Fruits up to 15 in each inflorescence, yellow to dark-brown when ripe . . . . . 2. *H. sibthorpioides*  
 2. Leaves usually more than 3 cm in diam. Stem creeping with ascending branches. Inflorescences single or in bundles, sessile to long-peduncled, usually along the ascending branches only. Fruits more than 15 in each inflorescence, blackish brown when ripe . . . . . 1. *H. javanica*

1. *Hydrocotyle javanica* THUNB. Diss. Hydroc. (1798) p. 3 no 17, p. 6, t. 2; BUW. Blumea 2 (1936) 122 (*lit.*).—*H. hirta* R. BR. ex RICH. Ann. Gén. Sc. Phys. 4 (1820) 64.—*H. nepalensis* HOOK. Exot. Fl. 1 (1823) t. 30.—*H. sundaica* BL. Bijdr. 15 (1826) 883.—*H. globata* BL. Bijdr. 15 (1826) 883.—*H. zeylanica* DC. Prod. 4 (1830) 67.—*H. podantha* MOLKENB. in MIQ. Pl. Jungh. (1851) 89.—*H. rotundifolia* (non DC., 1830) WARB. Bot. Jahrb. 13 (1891) 397.—*H. novo-guineensis* WARB. Bot. Jahrb. 16 (1892) 24.—*H. versteegii* HEMSL. Kew Bull. (1909) 259.

Stems rarely entirely erect, 10–50 cm, terete, glabrous or short-hairy. Stipules 3–8 by 4–6 mm broad-ovate, roundish to acute, membranaceous, entire or the apex fringed. Petioles 2–20 cm, short-hairy; lamina usually 3–8 cm through, rarely only  $1\frac{1}{2}$  cm, roundish to 5–8-angular in outline, cordate, 5–8-lobate, lobes crenate to crenate-serrate, more or less triangular, glabrous, rarely sparsely hairy. Inflorescences single or in groups, opposite to the leaves, sometimes united to an umbel with an involucre of few small bracts, sometimes also terminal. Peduncles 1–7 cm, rarely absent, glabrous or short-hairy. Involucres many around and between the flowers, 1 by  $\frac{3}{4}$  mm, ovate-acute, entire or base with small teeth, outer ones reflexed in fruit. Pedicels 15–50, 0– $\frac{1}{2}$  mm, rarely longer. Petals 1 by  $\frac{1}{2}$  mm, lanceolate, acute. Mericarps 1–

$1\frac{1}{4}$  by nearly  $\frac{3}{4}$  mm, glabrous or short hirsute or even with short curved hairs, sometimes red-punctulate when young, red-brown to blackish when ripe.

Distr. SE. and E. Asia to the Solomon Islands, Australia, Tasmania, and in tropical Africa, in Malaysia: all over the Archipelago, not yet found in the Lesser Sunda Islands, Madura and Kangean Islands.

Ecol. In shaded and forested places, 1–2900 m, but in the periodically dry parts of Central and E. Java not below 1000 m, rarely descending to 700 m near hot springs or along stream banks, decidedly avoiding the semi-arid regions.

Uses. Leaves as a fish-poison.

Vern. *Pegagah gajah* (Mal. Pen.); *pegagoh*, *pegagan*, *mangi-mangi* (Sum.); *dulang sontak*, *daun sontok*, S; variable in Javanese.

Notes. Small forms from high altitudes are difficult to separate from *H. sibthorpioides* LAMK. These specimens have at least 15 fruits in the umbellule, and for that reason I refer them to *H. javanica*. In New Guinea some specimens have very long-pedicelled flowers; there is a series of transitions to subsessile and sessile flowers.

2. *Hydrocotyle sibthorpioides* LAMK, ENC. Méth. Bot. 3 (1789) 153; BUW. Blumea 2 (1936) 128 (*lit.*).—*H. nitidula* RICH. Ann. Gén. Sc. Phys. 4 (1820)

60, t. 63, fig. 33.—*H. ranunculoides* var. *incisa* BL. Bijdr. 15 (1826) 884.—*H. splendens* BL. Bijdr. 15 (1826) 884.—*H. hirsuta* var. *minuta* BL. Bijdr. 15 (1826) 884.—*H. rotundifolia* DC. Prod. 4 (1830) 64.—*H. hirsuta* (non SW., nec SPRENG.) DC. Prod. 4 (1830) 67.—*H. latisecta* ZOLL. Syst. Verz. (1854) 138, 140.—*H. zollingeri* MOLKENB. in MIQ. Pl. Jungh. (1851) 91.—*H. puncticulata* MIQ. Fl. Ind. Bat. 1, 1 (1856) 732.—*H. benguetensis* ELM. Leaflet. Philip. Bot. 2 (1909) 628.—*H. delicata* ELM. Leaflet. Philip. Bot. 2 (1909) 629.—Fig. 1a-b.

Stems long-creeping or with ascendent extremities, sometimes almost caespitose, terete, thin or almost filiformous, glabrous or sparsely hairy. Stipules  $\frac{1}{2}$ –1 by nearly  $1\frac{1}{2}$  mm, ovate to obovate, acute, entire or fringed. Petioles  $\frac{1}{2}$ –6 cm, or even shorter in the uppermost leaves, more or less

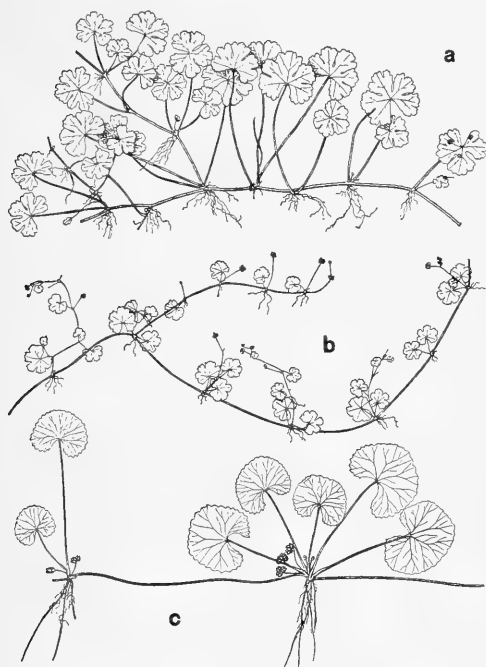


Fig. 1. a-b. *Hydrocotyle sibthorpioides* LAMK,  $\times \frac{1}{2}$ , c. *Centella asiatica* URBAN,  $\times \frac{1}{5}$ .

hairy; lamina  $\frac{1}{3}$ – $2\frac{1}{2}$  cm through, roundish to 5-angular in outline, deeply cordate, 3–5-lobate to 3–5-partite; segments crenate to serrate, more or less pilose to hirsute. Inflorescences single along the creeping stems; peduncles 0–3 cm, filiformous, glabrous or short hairy; involucre 4–10 around and between the flowers, nearly 1 by  $\frac{1}{2}$  mm, ovate, lanceolate, acute, base with 2 acute teeth, sometimes filiformous, lower ones reflexed in fruit. Pedicels 10–15; petals greenish white, nearly  $\frac{3}{4}$  by  $\frac{1}{2}$  mm, ovate, acute. Mericarps 1– $1\frac{1}{4}$  by  $\frac{3}{4}$  mm, yellow to brown, glabrous or with short stiff hairs, sometimes red-punctulate.

Distr. Australia, tropical Asia, tropical Africa, S. America (?), in Malaysia: all over the Archipelago.

Ecol. Sunny or slightly shaded, damp, fertile localities, along streambanks, between stones of pathways and alongside walls, from 1–4050 m.

Uses. Raw or steamed eaten with rice; medicinal against skin diseases.

Vern. Kurawet galeng, antanan in several combinations, S, sumud, samangi in several combinations, J, but Javanese names are rather variable; salatun, patekan tjena, Md.

Notes. Very variable as to leaf shape, depth of incisions, and hairiness; the numerous forms are connected by series of transitions.

3. *Hydrocotyle vulgaris* LINNÉ, Sp. Pl. 1 (1753) 234; BUW. Blumea 2 (1936) 133 (lit.).

Stems thin, creeping. Petioles 1–17 cm, with spreading hairs to the apex; lamina  $\frac{3}{4}$ – $3\frac{1}{2}$  cm through, orbicular, peltate, 8–13-nerved, coarsely crenate to slightly lobed. Inflorescences solitary or few together on the nodes; peduncles  $\frac{1}{2}$ –14 cm, filiformous; with 1–10 whorls of flowers, each flower with an ovate membranous, acute bract. Petals nearly  $\frac{3}{4}$  mm, ovate, white or reddish. Fruits smooth,  $\frac{1}{2}$ –2 by  $1\frac{3}{4}$ – $2\frac{1}{2}$  mm, transversely elliptical.

Distr. Europe, N. Africa, Australia, and the Marshall Islands, apparently absent in continental Asia; in Malaysia only in W. New Guinea (Arfak Mts).

Ecol. In open marshes,  $\pm$  2000 m.

Notes. Description after European and New Guinean materials. In Malaysian specimens the fruits are smooth, not covered with reddish warts as in the European form.

## 2. CENTELLA

LINNÉ, Pl. Afr. Rar. (1760) 28; BUW. Blumea 2 (1946) 133.—*Hydrocotyle* sect. *Centella* Bth. Fl. Austr. 3 (1866) 338.

Perennial, sometimes suffruticose, erect, prostrate, or rooting at the nodes. Leaves entire, crenate or lobate, palminerved; petioles with sheaths. Umbels simple, sessile or subsessile. Involucres few or 0. Calyx teeth obsolete. Petals entire, imbricate in bud; disk plane, margin elevate; styles from the base filiformous. Fruits laterally flattened, vittae 0; commissure narrow; mericarps with dorsal ribs marginate, lateral and intermediate ribs arcuate, all connected by veins, sometimes with 2–4 secondary ribs.

Distr. All over the world.

Note. *Solandra* L. Syst. ed. 10 (1759) 1269 is an older name for *Centella* but is rejected against the Solanaceous *Solandra* Sw. (1787); it is, therefore, not available in the *Umbelliferae*.

1. *Centella asiatica* (L.) URB. in MART. Fl. Bras. 11, 1 (1879) 287, t. 78, fig. 1; BUW. *Blumea* 2 (1936) 134.—*Pes equinus* RUMPH. Herb. Amb. 5, p. 455, t. 169, f. 1.—*Hydrocotyle asiatica* LINNÉ, Sp. Pl. 1 (1753) 234.—*Trisanthus cochinchinensis* LOUR. Fl. Coch. 1 (1790) 176.—*Hydrocotyle hebecarpa* DC. Prod. 4 (1830) 63.—*H. asiatica* var. *hebecarpa* HASSK. Pl. Jav. Rar. (1848) 459.—*H. asiatica* var. *pedunculata* O.K. Rev. Gen. 1 (1891) 268.—Fig. 1c.

Stems creeping with long stolons, more or less puberulous in the young state. Leaves in rosettes; petioles 1–40 cm, sometimes puberulous; lamina 1–7 cm diam., roundly reniform, crenate or crenate-dentate. Umbels solitary or 2–5 together in the axils of nearly 3 mm long bracts; peduncles 1/2–5 cm, shorter than the petioles. Flowers usually 3, middle one sessile, lateral ones pedicellate; in-

volucres 2, 3–4 by nearly 1 1/2 mm, ovate. Petals red, 1–1 1/2 by 3/4 mm. Mericarps about 2 by 1 1/2 mm, subhairy when young.

Distr. Pantropie, in *Malaysia*: all over the Archipelago.

Ecol. Sunny or slightly shaded, fertile, damp localities, along streambanks, also between stones of pathways and alongside walls, 1–2500 m.

Uses. Leaves raw or steamed eaten with rice. Medicinal uses many, especially against skin diseases and as a diuretic. Capacity for holding earth against erosion.

Vern. (daun) *Pegaga* (Mal. Pen., Sum., Born.) *daun kaki kuda*, *antan* in several combinations, S; *patjul gowang*, *rendeng*, *gagan-gagan*, J (but rather variable), *kolotide manora* (Tern.), *dogauke*, *gogauke*, *andan* (New Guinea).

### 3. TRACHYMENE

RUDGE, Trans. Linn. Soc. Lond. I, 10 (1811) 300; NORMAN, J. Bot. 69 (1931) 287; BUW. *Blumea* 2 (1936) 138.—*Didiscus* DC. in CURT. Bot. Mag. 55 (1828) t. 2875; DOMIN, Sitz. Ber. Böhm. Ges. Wiss. (1908) 2.

Annual or perennial, hirsute to glabrous, sometimes glandular-hairy. Stems erect, procumbent or ascendent, branched, often in a sympodial way. Leaves alternate along the stems, sometimes also in rosettes, roundish cordate to broadly cuneate, ternately divided, or entire, narrow-cuneate to subspathulate; petioles with sheaths. Umbels simple, terminal or opposite the leaves, sometimes in a corymbiform di-monochasium. Involucres linear. Calyx teeth minute, rarely subulate. Petals entire, imbricate in bud. Disk plane. Styles from the base filiform. Fruits laterally flattened, vittae 0; commissure narrow; mericarps with dorsal ribs, marginate, lateral ribs in the commissure, intermediate ribs arcuate, subprominent. Carpophore persistent, undivided.

Distr. This genus is chiefly Australian; outside Australia it is spread to New Caledonia and the Fiji Islands, in *Malaysia* it occurs in New Guinea, Timor, Flores, Celebes, Borneo, and the Philippines.

#### KEY TO THE SPECIES

1. Plant glandular-hairy.
  2. Ovary hairy; ripe fruits roughly tuberculate with glandular hairs; annual, erect, cultivated . . . . . 16. *T. caerulea*
  2. Ovary glabrous; ripe fruits smooth; wild mountain species . . . . . 11. *T. adenodes*
1. Plant not glandular-hairy.
  3. Leaves nearly triangular and somewhat hastate in outline, tripartite or ternate with the middle segment longer than the lateral ones . . . . . 6. *T. erodioides*
  3. Leaves never triangular hastate, more roundish or more cuneate in outline, if tripartite or ternate, then the middle segment hardly longer than the lateral ones.
    4. Leaves about as long as broad, base cuneate.
      5. Petiole at least twice as long as the lamina. Prolongated leafy stems absent. Stem not papillose. . . . . 2. *T. novoguineensis*
      5. Petiole at most as long as the blade. Leafy branched stems present. Stems, petioles, and peduncle densely papillose . . . . . 13. *T. flabellifolia*
    4. Leaves broader than long or longer than broad.
      6. Leaves longer than broad, all of them cuneate to spathulate.
        7. Pedicels 1–2. Leaf-blade spoon-shaped, 1-nerved, 2–2 1/2 by 1/2–3/4 mm, tip mucronate. Leaves densely imbricate. Cushion plant . . . . . 15. *T. pulvilliforma*

7. Pedicels at least 10. Leaf-blade otherwise, at least 7 by 3 mm, mostly with at least 3 apical teeth.
8. Leaves coriaceous and stiff, the lamina at least 5 times as long as broad . . . . . 4. *T. rigida*
8. Leaves not coriaceous and stiff, the lamina at most 3 times as long as broad.
9. Petiole at least twice as long as the lamina; prolonged leafy stems absent. 2. *T. novoguineensis*
9. Petiole as long as the lamina or shorter; leafy stems present.
10. Peduncles shorter than the leaves. Leaves subspathulate, not in rosettes but somewhat crowded towards the extremities of the stems . . . . . 14. *T. rosulans*
10. Peduncles longer than the leaves. Leaves cuneate.
11. Leaves broad-cuneate, 1–2½ by 1–3 cm, single or few together in axillary clusters 13. *T. flabelliformis*
11. Leaves narrow-cuneate, 1–2 by ½–1 cm, about twice as long as broad, in rosettes at the base of the stem and the branches. . . . . 3. *T. koebrensis*
6. Leaves broader than long, sometimes the upper ones cuneate, rarely also the lower broadly cuneate.
12. Stems procumbent; leaves to 1 cm long and broad, their teeth with apical hairs. 5. *T. acrotricha*
12. Stems erect or ascending, sometimes caespitose; leaves generally more than 1 cm long and broad, their teeth not with apical hairs.
13. Plants with rosettes at the base of the stems, sometimes also in the upper leaf axils and at the bases of the branches.
14. Umbels single from the rosettes, or moreover from the prostrate stems, but never forming a corymbiform dichasium . . . . . 1. *T. saniculaefolia*
14. Umbels forming a corymbiformous dichasium on more or less erect stems.
15. Calyx teeth at most ¾ mm long; leaves more or less divided, but not ternate. 7. *T. celebica*
15. Calyx teeth up to 2½ mm long; leaves ternate . . . . . 8. *T. sarasinorum*
13. No rosettes at the base of the stems and the branches, or if small rosettes are present at the base of the stems, these rosettes have disappeared before flowering and the umbels do not form a terminal corymb.
16. Leaves to 1–2 cm long and 3–4 cm broad; surface of stems, sheaths, and petioles densely papillose; fruit with knob-shaped trichomes . . . . . 12. *T. papillosa*
16. Leaves more than 2 cm long and 3 cm broad; stems, sheaths and petioles not papillose; fruits smooth.
17. Leaves not in rosettes but more densely placed in the lower thicker portion of the stem, 3-fid to ternate, biserrate with acute teeth . . . . . 9. *T. acerifolia*
17. Probably small rosettes at the very base of the stem, the latter very slender in its lower portion. Leaves 2½–7 by 4–8 cm, ternate with petiolulate leaflets, the latter serrate with broad, shortly acuminate teeth . . . . . 10. *T. arfakensis*

1. *Trachymene saniculaefolia* STAPF in HOOK. Ic. Pl. 24 (1894) t. 2308; BUW. Blumea 2 (1936) 141 (lit.).—*Didiscus saniculaefolius* MERR. Philip. J.Sc. Bot. 2 (1907) 255, 256, 292.—*Hydrocotyle azorella* F.v.M. J. Bot. 31 (1893) 324, *nomen*.

Perennial, reddish, more or less hirsute to glabrous; caudex with rosettes from which sympodial leafy stems with terminal inflorescences and axillary rosettes, flower-bearing or not. Stems terete, striate. *Sheaths* 5–10 by 2–3 mm, tapering into the petiole, ciliate; petioles 3–13 cm; lamina ¾–4 by 1–6 cm, roundly reniform to broadly cuneate, trifid to tripartite, even ternate, segments broadly rhomboid or narrower, sometimes divided again, apical part: ultimate segments serrate to lobate. *Umbels* terminal in the rosettes or on elongated stems opposite the leaves; peduncles 3–29 cm; involucre 7–25, 5–15 by 1–3 mm, lanceolate, acuminate, sometimes dentate, spreading, appressed in fruit; pedicels 5–more than 30, 5–15 mm, inner ones gradually shorter, spreading, incurved in fruit. Calyx teeth ½–2 by 1–1½ mm, triangular, acute, equally developed or one larger. Petals 2–2½ by ½–1½ mm, white to dark pink, ovate to lanceolate; styles ½–1½ mm. *Mericarps* 1½–3 by 1–2 mm, glabrous, reddish purple to purple.

Distr. Australia (N.S. Wales), in *Malaysia*:

Philippines (Mindoro), Br. N. Borneo and E. New Guinea.

Ecol. Open shallow damp places, at the base of rock walls at falls, rock crevices, grasslands, on burnt over ground and in forest glades, 1800–4020 m.

Uses. In Borneo used as Dusan medicine.

Notes. Rather variably as to the length of the stems, hairiness, shape and incision of the lamina.

2. *Trachymene novoguineensis* (DOMIN) BUW. Blumea 2 (1936) 144. fig. 2a.—*Didiscus saniculifolius* var. *novoguineensis* DOMIN, Sitz. Ber. Böhm. Ges. Wiss. (1908) 67.—Fig. 2a.

Perennial, often reddish, more or less hirsute to glabrous; caudex with rosettes, bearing again axillary rosettes; dwarf forms only 2–3 cm. *Leaf sheaths* 2½ by 3 mm, ciliate, tapering in the petiole; petioles 1–13 cm; lamina (3)–7–30 by (2½)–5–17 mm, cuneate, trilobate or trifid, apical part: segments with 2–3 subacuminate teeth. Peduncles (1½)–3½–37 cm, terete, striate or subsulcate; involucre 7–13, 8–12 by ½–1¼ mm, lanceolate, acute, glabrous or margin ciliate, spreading, appressed in fruit; pedicels 12–30, to 5 mm, inner ones gradually shorter, spreading, to 14 mm and incurved in fruit, glabrous. Calyx teeth ¼–½ mm,

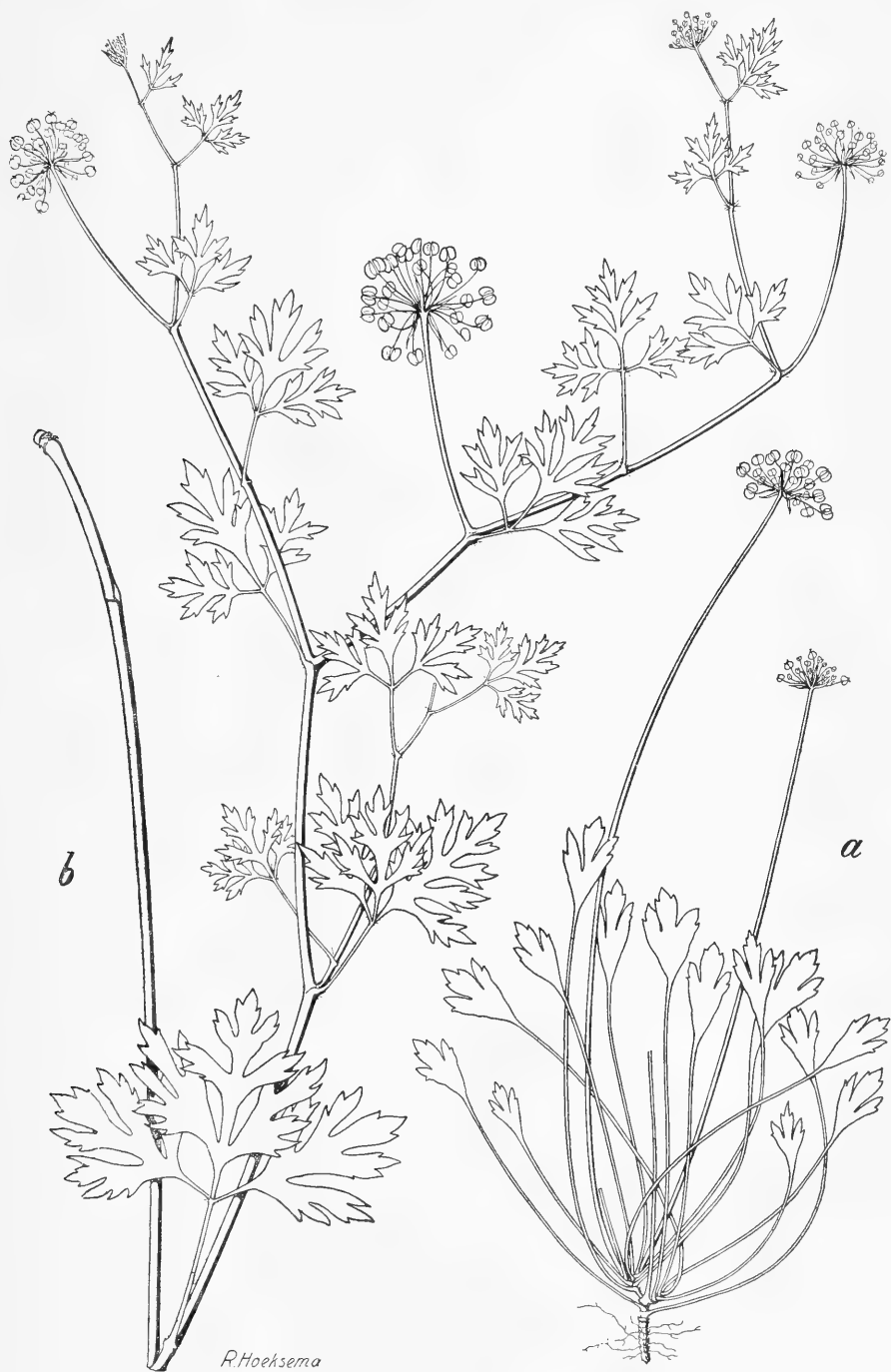


Fig. 2. a. *Trachymene novoguineensis* (DOMIN) BUW., b. *Trachymene arfakensis* (GIBBS) BUW.,  $\times \frac{2}{3}$ .



narrow or broad-triangular, somewhat enlarged in fruit. Petals  $c. 1\frac{1}{2}$  by  $\frac{3}{4}$  mm, creamy white, white or violet, elliptical. Styles to  $\frac{3}{4}$  mm. *Mericarps* to 3 by  $1\frac{1}{2}$  mm, glabrous, brown-yellow or tinged with red to dark violet.

Distr. *Malaysia*: W.-E. New Guinea.

Ecol. Open, stony localities, brook banks, marshy grasslands, 2700–3720 m.

**3. *Trachymene koebrensis* (GIBBS) BUW.** *Blumea* 2 (1936) 146, fig. 1a.—*Didiscus koebrensis* GIBBS, Contr. Arfak Mts (1917) 165.—**Fig. 3a.**

Perennial, entirely glabrous. Stems to 40 cm, erect or prostrate, sometimes finely papillose, with leaves over the whole length and rosettes in the leaf axils, densely set with swollen petiole-bases in the basal part and below the rosettes, with branches from the axillary rosettes, again with rosettes in the leaf axils. Sheaths nearly 2 by 3 mm, tapering into the petiole; petiole 1–2 cm, canaliculate above; lamina 1–2 by  $\frac{1}{2}$ –1 cm, cuneate, tapering into the petiole, apex with 3–5 triangular, acute teeth. Peduncle  $6\frac{1}{2}$ – $8\frac{1}{2}$  cm, terete, striate; involucre 5–13, nearly 6 by  $\frac{1}{2}$  mm, lanceolate, acute; pedicels 15–30, to 5 mm, the inner ones shorter, spreading, somewhat incurved in fruit. Calyx teeth  $\frac{3}{4}$ – $1\frac{1}{2}$  mm, narrowly triangular or subulate, sometimes unequally developed. Petals nearly  $1\frac{1}{4}$  by  $\frac{3}{4}$  mm, obovate, white or white with purple tinge; styles nearly  $1\frac{1}{4}$  mm. *Mericarps* to  $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm, tuberculate or smooth.

Distr. *Malaysia*: W. New Guinea.

Ecol. Open burnt localities and sterile limestone slopes, 2400–3225 m.

**4. *Trachymene rigida* BUW.** *Blumea* 2 (1936) 147, fig. 1 b–d.—*Didiscus odontocoleus* BUW. ex STEEN. Bull. Jard. Bot. Btzig III, 13 (1934) 255, *nomen*. **Fig. 3b–d.**

Perennial, entirely glabrous; branched caudex with rosettes from which sympodial leafy stems with terminal inflorescences and axillary few-leaved rosettes from which stems branched in the same mode. Stems procumbent, angulate, sulcate, at the nodes incrassate. Sheaths 1–3 mm long and broad with subulate thick coriaceous to 3 mm long appendages; petioles 2 by 0.1 cm, difficult to distinguish from the lamina; leaves with petiole 2–9 cm; lamina 4–7 mm broad, thick and stiff-coriaceous, narrow-cuneate-spathulate, apex with 1–5, mostly 3, obtuse, triangular teeth 3 by 1–2 mm; margin entire, subrecurved. Peduncles  $5\frac{1}{2}$ –11 cm,  $\frac{1}{2}$ – $1\frac{1}{2}$  mm thick, angulate, sulcate; involucre 10–12, 5–10 by  $\frac{1}{2}$ – $1\frac{1}{2}$  mm, lanceolate, acute or sub-obtuse; pedicels 20 or more, 2–4 mm, somewhat spreading, erect in fruit. Calyx teeth  $\frac{1}{4}$ – $\frac{3}{4}$  mm, obtuse, persistent. Petals  $1\frac{1}{2}$ –2 by 1 mm, oblong-ovate, inside white; styles  $1\frac{1}{2}$ –2 mm. *Mericarps* to 3 by  $2\frac{1}{2}$  mm, dark violet or brownish.

Distr. *Malaysia*: W. New Guinea.

Ecol. Open localities, 3000 m.

**5. *Trachymene acrotricha* BUW.** *Blumea* 2 (1936) 148, fig. 1e–f.—**Fig. 3e–f.**

Perennial; caudex at the top densely set with in-

crassate leaf rudiments. Stems to 13 cm, prostrate, sulcate, densely-hirsute towards the tip, hairs divaricate, to  $1\frac{1}{2}$  mm. Leaves sparse, rosettes absent; sheaths 4 by 2 mm, tapering into the petiole, margin long-ciliate, hairs to 3 mm; petiole to 7 cm, canaliculate, densely long-hirsute, hairs to 2 mm; lamina to 7 by 10–15 mm, of the lower leaves reniform, of the upper leaves rhomboid in outline, tripartite or trifid with cuneate segments, apical portion broad-dentate, teeth ending in an apical hair, subcoriaceous, involute when dried up, palm-nerved, glabrous above, beneath sparsely hirsute on the nerves. Umbels opposite the leaves in the upper portion of the stem; peduncles  $\frac{1}{2}$ –2 cm, densely hirsute; involucre 8–10, 4 mm, lanceolate, acute, canaliculate, glabrous with hairy teeth and tip; pedicels 10–20, to 4 mm, the inner ones shorter, glabrous, somewhat dilatate at the tip. Calyx teeth  $\frac{1}{2}$ –1 by 1 mm, elliptical, triangular, acute. Petals  $c. 1\frac{1}{2}$  by 1 mm, apiculate. Styles to  $\frac{3}{4}$  mm. *Mericarps*  $2\frac{1}{4}$ –3 by  $1\frac{1}{2}$ –2 mm, glabrous, ribs indistinct.

Distr. *Malaysia*: SW. Celebes.

Ecol. Stony localities, mountain heaths, 3100 m.

**6. *Trachymene erodioides* BUW.** *Blumea* 2 (1936) 149, fig. 1 g–h.—*Didiscus erodioides* BUW. ex STEEN. Bull. Jard. Bot. Btzig III, 13 (1934) 255, *nomen*.—**Fig. 3g–h.**

Small; stems creeping, terete, subincrassate at the nodes, hirsute or subhirsute, with hairs to 2 mm. Leaves single and in few-leaved axillary rosettes; sheaths  $ca$  2 by 1 mm, tapering into the petiole, outside densely hirsute, hairs 1–5 mm; petioles  $1\frac{1}{2}$ –4 cm, canaliculate, pilose with divaricate crisp hairs; lamina  $1\frac{1}{2}$ – $2\frac{1}{2}$  by 1–2 cm, in outline ovate-triangular, somewhat hastate, tripartite or ternate, terminal segment 1–2 by  $\frac{1}{2}$ – $1\frac{1}{2}$  cm, triangular-rhomboid, lateral segments 5–12 by 5–7 mm, ovate, all segments pinnatifid at the base, crenate towards the apex with short acuminate tips. Umbels terminal or from the axillary rosettes; peduncles  $2\frac{1}{2}$ –3  $\frac{1}{2}$  cm, ascending, slender, terete, striate, densely hairy, hairs 1–2 mm, crisp; involucre 5–6, 3–5 mm, lanceolate, glabrous or sub-ciliate; pedicels 12–15, to 7 mm, inner ones shorter, glabrous. Calyx teeth to  $\frac{1}{4}$  mm or absent (on the fruits). Styles  $\pm \frac{1}{2}$  mm. *Mericarps*  $2\frac{1}{2}$ –3 by nearly 2 mm, glabrous, equal or subequal.

Distr. *Malaysia*: SW. Celebes.

Ecol. Stony localities in mossy forest, 2700 m.

**7. *Trachymene celebica* HEMSL.** Kew Bull. (1896) 37; BUW. *Blumea* 2 (1936) 149.—*Didiscus celebicus* SARASIN, Reisen in Celebes 2 (1905) 337.—*Didiscus buginensis* WOLFF in FEDDE, Rep. 17 (1921) 439.

Perennial; caudex with rosettes from which flower-bearing stems and lateral rosettes, sessile or on short stolons from the upper leaf axils. Stems 20–50 cm, erect or ascending, nearly terete, more or less ribbed, densely hirsute to subhirsute, little branched and few-leaved beneath, terminated by a corymbiform inflorescence of umbels. Sheaths of the rosette leaves 2 by  $\frac{3}{4}$ – $1\frac{1}{3}$  cm, outside glabrous, towards the apex hirsute and ciliate, hairs 2–4 mm; petioles 5–15 cm, hirsute; lamina



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Fig. 3. a. *Trachymene koebrensis* (GIBBS) BUW., b-d. *Trachymene rigida* BUW., e-f. *Trachymene acrotricha* BUW., g-h. *Trachymene erodioides* BUW. (plants  $\times \frac{2}{3}$ , fruits  $\times 4$ ).

5–13 by 7–14 cm, in outline roundish, deeply cordate, 3–7-palmatifid, segments obovate, 3-lobed, biserrate, densely hirsute; cauline leaves and inflorescence bracts gradually smaller and shorter petioled, uppermost ones subsessile with less numerous and narrower segments and smaller sheaths. *Peduncles* 2½–6 cm, upper ones shorter; involucre numerous, nearly 10 mm, narrowly lanceolate, long-acuminate, appressed; pedicels more than 50, up to 17 mm, inner ones shorter, spreading, incurved in fruit. Calyx teeth small, acute, persistent. Petals white, nearly 2½ by 1½ mm, elliptic, acute. Styles nearly 3 mm, persistent. *Mericarps* nearly 4 by 3 mm, red.

Distr. *Malaysia*: SW. Celebes.

Ecol. Open, stony localities, 2300–3000 m.

Uses. Roots (raw) as medicine against stomach-ache.

Vern. *Kriongo*, *djahé merah*.

**8. *Trachymene sarasinorum* (WOLFF) BUW.** *Blumea* 2 (1936) 151.—*Didiscus sarasinorum* WOLFF in FEDDE, Rep. 17 (1921) 440.

Perennial; caudex with rosettes from which flower-bearing stems and lateral rosettes, sessile or on short stolons from the upper leaf axils. Stems erect, 30–40 cm, terete, striate, sparingly hirsute, more densely at the nodes. *Leaves* nearly all in a rosette; sheaths 3–6 by 5–8 mm, at the back and the margin with 1–2 mm long hairs, abruptly contracted into the petiole; petiole 6–8 cm, hirsute, more densely towards the lamina; lamina 4–4½ by 6–7 cm, roundish in outline, deeply cordate, ternate, the central leaflet nearly 4 by 3½ cm, tripartite, lateral leaflets hardly smaller, obliquely trifid, all ultimate segments 2–3-lobed, coarsely serrate, rather sparingly appressedly hirsute; cauline leaves smaller, shorter petioled, bracts of the dichasium nearly sessile. *Peduncles* 3–4 cm, terete, striate, shortly hirsute; involucre numerous, 7–10 by ½ mm, narrowly lanceolate, acuminate with few hairs at the margin and on the midrib, spreading, appressed in fruit; *pedicels* 7–11 mm, spreading, suberect in fruit. Calyx teeth nearly 2½ mm, subulate. Petals 2–2½ by 1 mm, ovate, white. Styles nearly 2 mm. *Mericarps* nearly 4½ by 3½ mm, entirely glabrous.

Distr. *Malaysia*: SW. Celebes.

Ecol. Probably open, stony localities, 1100 m.

**9. *Trachymene acerifolia* NORMAN**, Journ. Bot. 69 (1931) 287; BUW. *Blumea* 2 (1936) 151, fig. 3.—*Didiscus acerifolia* STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 255.

Stems 20–45 cm, erect and terete in the lower portion, terete or subangular in the upper part, with spreading branches, the whole densely velvety hairy with yellowish brown indumentum, glabrescent; glabrous in the young state. *Leaves* rather densely set in the basal part, more remote upwards, hirsute to glabrous; petioles of the lower leaves to 13½ cm, gradually shorter upwards, in the upper leaves nearly absent, all of them slightly sheathing at the base, hairy like the stems; lamina palmatifid to ternate, segments rhomboid to obo-

vate, the middle one 3-lobate to trifid, besides, all biserrate with acuminate teeth; lamina of the upper leaves smaller and more cuneate. *Umbels* opposite the leaves; peduncles 1–5 cm, to 7 cm in fruit, terete, grooved, hairy like the stems; involucre 7–10, to 3 mm broad, shorter as or as long as the pedicels, lanceolate, hairy like the leaves; pedicels 25–40, to 7 mm, to 15 mm in fruit, inner ones shorter. Calyx teeth to ½ mm, acute or obtuse. Petals to 2 by 1 mm, cream to pink, elliptical, acute. Styles nearly ½ mm, to 1½ mm in fruit. *Mericarps* to 6 by 4 mm, equal.

Distr. *Malaysia*: Lesser Sunda Islands (Timor, Flores), SE. Celebes.

Ecol. In mountain forests, damp places, 1800–2600 m.

Notes. The specimens from Celebes differ from those from the Lesser Sunda Islands by stronger developed leaf sheaths, by broader involucre which enclose the flower when young, and by pink to purple flowers.

**10. *Trachymene arfakensis* BUW.** *Blumea* 2 (1936), 154, fig. 2b.—*Didiscus arfakensis* GIBBS, Contr. Arfak Mts (1917) 166.—Fig. 2b.

Stems to 60 cm, erect or suberect, glabrous, slender, base thickened with scars and remnants of leaf sheaths, unbranched in the lower portion, terete, striate to subsulcate, several times dichotomously branched in the upper part, branches spreading and sympodial. Sheath 2–7 by 1½–4 mm, tapering into the petiole, ciliate with hairs to 2 mm; petioles 2–7 cm in the lower leaves, gradually shorter upwards, canaliculate, glabrous or towards the lamina with few to 2 mm long hairs; lamina 2½–7 by 4–8 cm, roundish-cordate, ternate, leaflets with petiolules to 1½ cm, 2–3-fid to 2–3-partite, segments 3-lobed and coarsely serrate, teeth acuminate and apiculate, upper surface subglabrous, beneath sparingly hirsute, especially on the nerves, base long-ciliate. *Umbels* opposite to each other leaf; peduncles 1¼–7 cm, terete to sulcate, involucre 5–10, 5–10 mm, linear to filiform, broadest ones with few filiform teeth; *pedicels* 20–30, 5–8 mm, 10–15 mm in fruit, spreading, inner ones shorter. Calyx teeth hardly any. Petals 1–1½ by ¾–1 mm, white, ovate, acute. Styles 1–1½ mm. *Mericarps* to 5 by 3 mm.

Distr. *Malaysia*: Celebes, W. New Guinea (Mt Arfak).

Ecol. Marshy, muddy localities, often in groups, 1500–2400 m.

**11. *Trachymene adenodes* BUW.** *Blumea* 2 (1936) 155, fig. 4a–b.—Fig. 4a–b.

Stems to 50 cm and more, terete, striate, lower portion ascendent with rosettes at the base, glabrous, unbranched, upper portion dichotomously later sympodially branched, densely hirsute, hairs to 2 mm. *Leaves* rather densely in the lower portion, upwards more remote; sheaths 5–8 by 3–5 mm, semi-amplexicaulous, tapering into the petiole, glabrous, margin long-ciliate with partly glandular hairs to 3 mm; petioles 7–20 cm, upwards gradually shorter, uppermost ones nearly



Fig. 4. a-b. *Trachymene adenodes* Buw., c. *Trachymene papillosa* Buw. (plants  $\times \frac{2}{3}$ , b. glandular hair of the petiole  $\times 16$ , d.  $\times 4$ )

absent, towards the lamina densely hirsute with glandular hairs to 3 mm; lamina of the rosette leaves and lower leaves  $4\frac{1}{2}$  by  $7\frac{1}{2}$  cm, roundish-cordate to subreniform, 3–5-partite to ternate, segments rhomboid-ovate, middle ones trifid with 2–3-lobate parts, all segments moreover serrate with broad, subacuminate to subapiculate teeth, sparsely pilose with partly glandular appressed hairs, to 2 cm especially towards the margin and in the incisions. *Umbels* opposite the leaves and in the bifurcations; peduncles to 10 cm, shorter towards the end of the stems, towards the top with glandular hairs; involucre 6–8, 7–10 by  $1\frac{1}{2}$  mm, lanceolate, acute, glabrous or long-ciliate; pedicels  $\pm$  30, 7–9 mm, inner ones shorter, glabrous. Calyx teeth nearly  $\frac{1}{4}$  mm, broad-triangular. Petals  $1\frac{1}{2}$ –2 by  $1\frac{1}{2}$  mm, obovate. Styles  $\pm$   $1\frac{1}{2}$  mm. *Mericarps* (unripe) 2 by  $3\frac{1}{4}$  mm, glabrous.

Distr. *Malaysia*: NE. New Guinea.

Ecol. Mountains, 2400–3000 m.

Notes. When more material will come to hand this species might possibly appear to be referable to *T. arfakensis* which it resembles in leaf shape but from which it differs by its longer petioles, longer peduncles and the glandular indumentum of the petioles, stems and peduncles. As yet I have seen no transitional forms.

**12. *Trachymene papillosa* Buw.** *Blumea* 2 (1936) 157, fig. 4c–d.—*Didiscus scabriusculus* Buw. ex STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 255, *nomen*.—Fig. 4c.

Stems 20–40 cm, probably ascendent, terete, densely papillose and densely hirsute with 1 mm long, stiff hairs, branched in the upper portion. *Leaves* sparse; sheaths 2–3 by 2 mm, semi-amplexicaulous, tapering into the petiole, papillose like the stem, above long-ciliate, hairs 1–2 mm; petioles  $\frac{1}{2}$ – $2\frac{1}{2}$  cm, hirsute and papillose like the stems; lamina 1–2 by 3–4 cm, orbicular-reniform in outline, ternate; leaflets 1–2 by  $1\frac{1}{2}$  cm, attenuate towards the base, 2–3-fid or 2–3-partite, terminal segments often biserrate, at the base papillose to glabrous, on both sides sparsely hirsute to glabrous. *Umbels* terminal, often opposite the leaves; peduncles 3– $8\frac{1}{2}$  cm, terete, striate, hirsute and papillose like the stem or glabrous; involucre 6–12, 4–5 by  $\frac{1}{2}$ –1 mm, linear-lanceolate, acute, glabrous or long-ciliate; pedicels 30–50, to 5 mm, inner ones shorter, glabrous, spreading, erect to reflexed in fruit. Calyx teeth  $\frac{1}{4}$ – $\frac{1}{2}$  mm long and broad, triangular, equal. Petals circa  $1\frac{1}{2}$  mm, reddish white, ovate, acute. Style  $1\frac{1}{2}$  mm. *Mericarps* to 2 mm long and broad, equal, black, with tuberculiform scales, especially between the intermediate ribs and the commissure, to entirely smooth.

Distr. *Malaysia*: SW. New Guinea (Central Range).

Ecol. Grassy, deforested slopes, on sandy soil, also forest edges, 1600–3500 m.

**13. *Trachymene flabellifolia* n. sp.**

*Species nova ad Tr. papillosam* Buw. *accedens tamen foliis cuneatis flabelliformibus distinguenda*.

Perennial herb. Rhizome 7–12 mm thick; stems

up to 30 cm long, branching from the base, ascendent, furrowed or subangulate, near the base black-corky, roughish, upper part densely papillose and hirsute (hairs up to 1 mm long, appressed, and stiffish). *Leaves* single or few together in axillary clusters, 5–15 mm apart; sheath 2–3 mm long,  $1\frac{1}{2}$ –2 mm wide, narrowing to the petiole and on the margin ciliate (hairs up to 2 mm long); petiole 6–11 mm long, sparsely hirsute (hairs up to 1 mm long); blade  $1\frac{1}{2}$ –2 cm long, 1–3 cm wide, fan-shaped, incised or split into 2–3-parted wedge-shaped segments, at the tip sharply toothed; main nerves on both surfaces distinctly flabellate. *Umbels* placed in the upper part of the stem opposite the leaves; peduncle terete, striate, subpapillose,  $2\frac{1}{2}$ – $5\frac{1}{2}$  cm long, sparsely hirsute (hairs up to  $1\frac{1}{2}$  mm long, spreading); bracts forming an involucre, 11 or less, up to 11 mm long and c.  $\frac{3}{4}$  mm wide, acute, lanceolate, at the base connate; pedicels 30–50, terete, slender, glabrous, the outer up to 5 mm long, the inner shorter, slightly longer when in fruit. Calyx with c.  $\frac{1}{4}$  mm long, sharp teeth. Petals  $\frac{3}{4}$ –1 mm long, c. 1 mm wide, ovate, subconcave. Stamens 5, anthers dorsifix, rounded-elliptic. Styles 2, subfiliform,  $1\frac{1}{4}$ – $1\frac{1}{2}$  long, curved inwards. *Fruit* much flattened, kidney-shaped. *Mericarps* up to 3 mm long and up to  $2\frac{1}{2}$  mm wide, median rim c. 1 mm distant from the commissure, slightly crowned by the styles, densely covered by knobby hair-like outgrowths; carpophore entire,  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm long, hardly two-tipped.

Distr. *Malaysia*: West New Guinea (Central Range, near Lake Habbema, 3225 m camp, BRASS 9586, *type*).

Ecol. Common in mossy glades, 3225 m alt.

Notes. Allied to *T. papillosa* but different by its cuneate to flabelliform leaves.

**14. *Trachymene rosulans* (DANS.) Buw.** *Blumea* 2 (1936) 158.—*Didiscus rosulans* DANS. *Brittonia* 2 (1936) 135, *cum icone*.

Perennial (or annual). Main root fusiform, branched. Main stem erect, to 13 cm, at the base to  $2\frac{1}{2}$  mm thick, almost covered with the thickened bases of leaf sheaths, producing procumbent or ascendent branches, with scale-like leaves, to 14 cm; upper portion with branches that are like the upper portion of the main stem, whole plant a semi-globose whole. *Leaves* scattered, more densely set towards the extremities, somewhat forming terminal rosettes; sheaths 2–12 by 3 mm, with membranous margin, tapering into the lamina; lamina 8–18 by 3–9 mm, spatulate, apical portion with 3 acute or obtuse teeth. *Umbels* opposite the leaves; peduncles 5–12 mm, terete, striate; involucre 8–12, 6–9 by  $1\frac{1}{2}$  mm, lanceolate; pedicels 10–20, 4–7 mm, inner ones shorter, hardly elongated in fruit. Calyx teeth to  $\frac{3}{4}$  mm, triangular, acute. Petals nearly,  $1\frac{1}{2}$  by 1 mm, pink or pale pink, roundish-elliptical; styles nearly  $1\frac{1}{4}$  mm. *Mericarps* to  $\frac{3}{2}$  by 3 mm, entirely glabrous.

Distr. *Malaysia*: SE. New Guinea.

Ecol. Open places, burnt fringes of forest, grasslands, 2840 m.

**15. *Trachymene pulvilliforma* n. sp.**

*Ab omnibus speciebus generis Trachymene differt modo crescendi, pulvillos densos formante, foliis densissime imbricatis apicem caulis versus et magis minusve in rosulas confertis. Pars inferior folii semi-amplexicaulis et vaginans, lamina cochlearis 2-2½ mm longa, ½-¾ mm lata, apice mucronata, uninervata. Umbellae simplices, brevissime pedunculatae bracteae 2-4 involucreatae, pedicellis 1-2. Ex affinitatis T. rosulans (DANSER) BUW.*

A herb, probably perennial, entirely glabrous; root fusiform, branching, fibrous; stem prostrate and much branching from the base, branches close, the slightly ascending upper ones forming a half-spherical cushion which is up to 1 cm deep and 5-15 cm in diam. Leaves very densely imbricate, near the top more or less in clusters together, the basal part half amplexicaulous and sheathing; sheath appressed, 1½-3 mm long, ½-1 mm broad, narrowing towards the blade; blade spoon-shaped, 2-2½ mm long, ½-¾ mm wide, one-nerved, tip mucronate. Umbels terminal or opposite the leaf clusters, when flowering hidden among the leaves, when in fruit slightly exserted; peduncle somewhat flattened c. 2 mm long; bracts 2-4, forming an involucre, 1½-2 mm long, up to ½ mm wide, lanceolate or spatulate-lanceolate. Pedicels 1-2, slightly flattened, c. 1 mm long, in fruit up to 2½ mm long. Calyx indistinctly toothed. Petals 5, c. 1 mm long, c. ¾ mm wide, white. Stamens 5, anthers dorsifix, rounded-elliptical, pink. Styles 2, subfiliform, c. ½ mm long. Fruit glabrous, strongly flattened, kidney-shaped. Mericarps up to 2 mm long and up to 1½ mm wide, rim indistinct, the median ¾ mm distant from the commissures, slightly crowned by the styles, carpophore entire, c. 1 mm long, hardly two-tipped.

Distr. *Malaysia*: West New Guinea, (3 miles E

of the summit of Mt Wilhelmina, BRASS 9426, type).

Ecol. Forming bright green cushions, c. 5-15 cm in diam. on old camp site, 3650 m alt.

Notes. Different from all other *spp.* by its dense mode of growth, its peculiar leaf-shape, and its umbels being 1-2-pedicelled. In mode of growth it comes nearest to *T. rosulans*.

**16. *Trachymene caerulea* GRAH. Edinb. New Phil. Journ. 5 (1828) 380; BUW. Blumea 2 (1936) 158. —*Didiscus caeruleus* HOOK. in CURT. Bot. Mag. 55 (1828) t. 2875. — *D. cyaneus* DC. Mém. Omb. 11 (1829) 28. — *Huegelia caerulea* REICHENB. Iconogr. Exot. (1829) t. 20.**

Annual, pilose and glandular in nearly all parts. Main root fusiform with fibrous branches. Stems single, erect, upper portion with usually simple branches not overtopping the main stem. Lower leaves petioled, petioles 1½-4 cm, hardly sheathing; lamina roundish in outline, ternate, leaflets bipinnatifid to bipinnatifid, segments narrow with subacute to subobtusely apiculate tips; upper leaves sessile or subsessile, less divided, uppermost ones with only 3 narrow segments. Umbels terminal on the main stem and the branches, ∞-flowered; involucre ∞, linear, nearly filiform towards the tip, nearly as long as the flowers; pedicels 10-25 mm, inner ones gradually shorter, spreading, more erect in fruit. Outermost flowers larger than the other ones, not fruit-bearing, probably male. Calyx teeth very short, subulate. Petals 2½-3 by 2-2¼ mm, ovate to obovate, shortly unguiculate at the base, outside with short glandular hairs. Styles nearly 1 mm; ovary glandular hairy. Mericarps 3¼ by up to 2¾ mm, roughly tuberculate with glandular hairs.

Distr. Australia, in *Malaysia*: cultivated as a garden plant.

**4. SANICULA**

LINNÉ, Sp.Pl. 1 (1753) 235; BUW. Blumea 2 (1936) 159 (*lit.*).

Erect herbs; leaves palmately 3-5-partite, segments dentate, lobed or pinnately dissected. Flowers in irregular compound umbels with few rays; involucre leaf-like; umbellules usually small, with small involucels. Calyx teeth subherbaceous or membranaceous. Petals white, emarginate with inflexed tip, slightly imbricate. Disk flat with raised margin encircling the styles. Styles from the base filiform or subincrassate. Fruits echinate, ovoid, subterete or laterally subflattened; commissure broad; mericarps with obscure ribs, lateral ones in the commissure, inner surface flat; vittae slender, solitary in each ridge, some very slender scattered in the endosperm.

Distr. About 40 *spp.* (depending on specific delimitation) distributed throughout the world and in Hawaii and Patagonia, but not in Australia and New Zealand.

**1. *Sanicula europaea* LINNÉ, Sp.Pl. 1 (1753) 235; BUW. Blumea 2 (1936) 159 (*lit.*). — *S. elata* D. DON, Prod. Fl. Nep. (1825) 183. — *S. javanica* BL. Bijdr. 15 (1826) 882. — *S. montana* BL. Bijdr. 15 (1826) 882; MOLKENB. in MIQ. Pl. Jungh. (1851) 93, *cum var. genuina, javanica, divaricata*. — *S. montana* var.**

*genuina*, var. *javanica* ZOLL. Syst. Verz. (1854) 138. — *S. elata* var. *normalis*, var. *partita* O.K. Rev. Gen. Pl. 1 (1891) 269. — *S. europaea* var. *javanica* WOLFF in Pfl.R. 61 (1913) 64.

Perennial with more or less creeping rhizomes. Stems 15-75 cm, slender, deeply grooved, glabrous

or rarely like the whole plant hairy. Petiole of the lower leaves 3–20 cm, lamina tripartite to ternate, segments incised and serrate-crenulate, teeth mucronulate. *Umbels* in a dichasium, ending in monochasia, sessile or on peduncles up to  $1\frac{1}{2}$  cm, with 5–8 involucre, 4–6 flowered, with 2–3 outer male flowers on pedicels  $\frac{1}{2}$ –1 mm, and 2–4 female flowers, sessile or on pedicels up to  $\frac{1}{2}$  mm. Calyx teeth  $1\frac{1}{2}$ –1 by  $\frac{1}{4}$  mm, oblong, acute. Petals nearly  $1\frac{1}{4}$ –by  $\frac{1}{2}$  mm, with inflexed tip. *Mericarps* nearly 2 by 1 mm, densely covered with about  $1\frac{1}{2}$  mm long uncinat bristles.

### 5. ERYNGIUM

LINNÉ, Sp.Pl. 1 (1753) 232; BUW. Blumea 2 (1936) 164 (lit.).

Erect herbs, often spinescent. *Leaves* spiny dentate, entire, lobed or dissected. *Flowers* in heads or compact spikes, all bracteolate. Calyx teeth rigid, acute or prickly. Petals erect, white, with inflexed tip, scarcely imbricate. Disk flat, raised margin encircling the styles. Styles from the base filiform. *Fruit* ellipsoid, nearly cylindrical, commissure broad; mericarps with subprominent ribs, inner surface subconcave; vittae inconspicuous or 0; carpophore deciduous.

Distr. Over 200 spp. described, distributed throughout the world with exception of trop. & S. Africa, centering in the New World specially Mexico, in the tropics usually on the mountains, *E. rostratum* circum-S. Pacific.

#### KEY TO THE SPECIES

- |   |                         |
|---|-------------------------|
| 1. Radical leaves simple, with a dentate margin . . . . . | 1. <i>E. foetidum</i>   |
| 1. Radical leaves distinctly 2-pinnately lobed . . . . .  | 2. <i>E. moluccanum</i> |



Fig. 5. *Eryngium foetidum* L.,  $\times \frac{1}{5}$ .

Distr. Temperate and tropical parts of Europe, Africa and Asia; in *Malaysia*: all over the Archipelago eastwards to Ceram.

Ecol. Mountain forests, 500–3060 m.

Vern. *Daun ketapan, kundje, tespong, tetespongan*, S; Javanese names rather variable.

Notes. The Malaysian material is rather uniform; it differs from the European form by its umbels arranged in widely branched di-monochasia, whereas the latter has more crowded inflorescences and consequently nearly compound umbels.

1. *Eryngium foetidum* LINNÉ, Sp.Pl. 1 (1753) 232.—BUW. Blumea 2 (1936) 164.—Fig. 5.

Roots fusiform. Stems 15–60 cm, manytimes dimonochasially branched with spreading branches, subglabrous, grooved. *Leaves* nearly all in a rosette, 3–32 by 1–4 cm, glabrous, lanceolate-spathulate, obtuse, sessile, base more or less narrowly sheathy, margin dentate, teeth with a spiny hair. Bracts of the inflorescences 1–6 cm, palmatilobate to -partite, with spiny tips and teeth, strongly nerved, lowermost often like normal leaves. Peduncles 1–10 mm; heads 5–10 mm, cylindrical; involucre 5–7, spreading, nearly lanceolate with few spiny teeth. *Flowers* sessile in the axils of narrow membranous-margined bracts  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long. Calyx teeth nearly  $\frac{3}{4}$  mm, lanceolate, acute with narrow membranous margin. Petals  $\frac{1}{2}$ – $\frac{3}{4}$  by  $\pm \frac{1}{4}$  mm, greenish white. *Mericarps* 1– $1\frac{1}{2}$  by  $\frac{1}{2}$ – $\frac{3}{4}$  mm, densely warty, glabrous, ribs indistinct.

Distr. Indigenous in tropical America, introduced in some parts of tropical Africa and Asia; in *Malaysia*: Malay Peninsula, Sumatra, Java.

Ecol. In not too dry regions, in shaded or sunny, fertile localities, arable lands and grasslands, sawah-dikes, forest edges and along streambanks.

Uses. Raw or steamed eaten with rice.

Vern. *Kangkong kerbau, jeraju gunung* (Mal. Pen.); *umbu Palembang, ketumbor djawa* (Sum.); (*rumpu*) *walang, katuntjar walanda, katuntjar blanda* *walang* in several combinations, S, *tumbaran unga, ketumbar landa, ketul kebo, djinten, djintenan, J; stinkdistel* (Dutch).

Notes. In the Malay Peninsula for the first time collected in 1888; in Java observed as early as 1896 [EDELING, Nat. Tijds. Ned. Ind. 31 (1870) 294], in Sumatra in 1915.

The plants smell of bugs caused by an aromatic oil containing the aldehyd dodecen-2-al-1 (KOOL-HAAS, Rec. trav. chim. Pays-Bas 51 (1932) 460).

**2. *Eryngium moluccanum* n. sp. prov.**

Habit of *E. campestre*. Leaves petioled, broad triangular-ovate in outline, 10–15 cm through, prickly. Stem little branched. Heads oblong.

## 6. CHAEREFOLIUM

HALL. Hist. Stirp. Helv. 1 (1768) 327; BUW. Blumea 2 (1936) 168.—*Anthriscus* PERS. Syn. 1 (1805) 320.

**1. *Chaerefolium cerefolium* SCHINZ & THELL.** Vierteljahrsschr. Naturf. Gesell. Zürich 53 (1909) 554; BUW. Blumea 2 (1936) 168.—*Scandix cerefolium* LINNÉ, Sp.Pl. 1 (1753) 257.—*Anthriscus cerefolium* HOFFM. Gen. Pl. Umbell. (1814) 41.

Herb, somewhat hirsute. Stems 25–50 cm, striate and grooved. Lower leaves with petioles to 7 cm with sheathing base, upper leaves subsessile to sessile on the sheaths; lamina 4–11 by 3–15 cm, triangular in outline, bi- to tripinnate, primary leaflets ovate, obtuse,  $1/2$ – $2/2$  cm petiolulate, secondary leaflets ovate, pinnatifid, with obtuse tips. Compound umbels sessile in a di-monochasium; rays 3–5, 5–25 mm; pedicels 4–9, 2–4 mm, to 5 mm

Distr. *Malaysia*: Moluccas (Ceram, summit zone of Mt Pinaja, ca 3000 m alt., EYMA a. 1937/8).

Notes. A provisional examination in 1940 of the rather few specimens of this most remarkable discovery by the late Dr EYMA gave as a result that it was a new species, probably allied to some Australian species. Unfortunately the specimens cannot be traced, and are probably lost. (v. St.).

in fruit; involucre absent; involucels 3–4, nearly 2 by  $3/4$  mm, lanceolate, acute with narrow membranous margin. Petals nearly  $1$ – $1\frac{1}{2}$  by  $1/2$ –1 mm, white, obcordate with short inflexed tips. Mericarps 5–6 by 1 mm, sometimes antrorsely hirsute when unripe, black and finely granular when ripe, grooved inside, with a beak to  $2\frac{1}{2}$  mm; disk flat.

Distr. Indigenous in SE. Europe and W. Asia, cultivated and spontaneous in all parts of the world; in *Malaysia* stated to be cultivated in Java [MIQ. Fl. Ind. Bat. I, 1 (1856) 744].

Notes. Description after European materials; no specimens from Malaysia seen by me.

## 7. TORILIS

ADANS. Fam. Pl. 2 (1763) 99; BUW. Blumea 2 (1936) 169.—*Caucalis* BENTH. & HOOK. f. Gen. Pl. 1 (1867) 928, *pro parte*.

Annual to perennial erect herbs, retrorsely pubescent. Leaves pinnately divided. Umbels compound, rays often few. Involucres many to 0, involucels many. Flowers white or reddish, outer ones radiating. Calyx teeth triangular, acute. Petals cuneate or obovate, emarginate, with inflexed tips. Disk continuous with the base of the styles. Fruits ovate to oblong, laterally subflattened, constricted at the broad commissure; mericarps with primary and secondary ribs obscure or subprominent, lateral ribs in the commissure, muricate-setose, inner face sulcate; carpophore entire or 2-fid.

**1. *Torilis japonica* DC.** Prodr. 4 (1830) 219; BUW. Blumea 2 (1936) 169.—*Tordylium anthriscus* LINNÉ, Sp.Pl. 1 (1753) 240.—*Caucalis anthriscus* HUDS. Fl. Angl. ed. 1 (1762) 99.—*Caucalis japonica* HOUTT. Nat. Hist. II, 8 (1777) p. 42, t. 45, 1.—*Torilis anthriscus* (non GAERTN. 1788) GMEL. Fl. Bad. 1 (1806) 615.—*Torilis scabra* (non DC. 1830) ZOLL. Syst. Verz. (1854) 139.

Stems to more than 1 m, finely striate, rough by appressed bristles. Leaves triangular in outline, sparingly appressedly hirsute, pinnate, leaflets pinnatifid, segments pinnatifid to serrate. Umbels terminal and axillary; peduncles 5–20 cm; rays 4–12,  $1/2$ –3 cm; pedicels 4–10, 1–4 mm, all antrorsely

hirsute; involucre 2–6; involucels 3–7, nearly filiform. Calyx teeth nearly  $1/2$  mm, triangular-lanceolate, mucronulate. Petals  $1/2$ –1 mm through, appressedly hairy outside. Mericarps about 4 by  $1\frac{1}{2}$  mm, oblong, ribs obtuse, grooves with densely placed uncinat bristles.

Distr. Indigenous in Europe, N. Africa, temperate Asia, Himalayan Mts, introduced in S. Asia and America, in *Malaysia*: N. half of Sumatra and E. Java (Mt Tengger).

Ecol. Mountains, 1225–2500 m.

Vern. Ambo-ambo (Sum.), tumbaran alas, J.

Notes. This species is said to have been introduced in S. Asia and America among clover seed.

## 8. CORIANDRUM

LINNÉ, Sp.Pl. 1 (1753) 256; BUW. Blumea 2 (1936) 170.



1. *Coriandrum sativum* LINNÉ, Sp.Pl. (1753) 256; MERR. Comm. Lour. (1935) 294; BUW. Blumea 2 (1936) 171.—*Coriandrum testiculatum* (non L.) LOUR. Fl. Cochinch. (1790) 180.—*Bifora loureirii* KOSTEL. Allg. Med.-Pharm. Fl. 4 (1835) 1183.—*Atrema testiculatum* MIQ. Fl. Ind. Bat. 1, 1 (1856) 744.

Annual, entirely glabrous. Stems to 75 cm, terete, striate. Lower leaves palmatilobate to -partite, middle leaves pinnate, segments gradually narrower, obtuse, upper leaves pinnate to bipinnate, segments  $\frac{1}{2}$  mm broad. Compound umbels terminal or seemingly lateral, peduncles 2–10 cm; rays 3–5, 1–2½ cm; pedicels 3–5 mm; involucre 0–1, to 5 mm; involucels 3–5, to 5 by ½ mm, linear. Calyx teeth nearly 1 mm, triangular-lanceolate to oblong-lanceolate, somewhat radiating. *Petals*

white, radiating, outer ones 3–4 mm, all deeply bipartite with inflexed tips. *Mericarps* 4 by 2 mm, inside hollow, forming a nearly globose fruit; primary ribs undulated lines, secondary ribs subprominent, filiformous.

Distr. Indigenous from the Mediterranean region to central Asia; cultivated in nearly all parts of the world, in *Malaysia*: cultivated from 0–2200 m.

Uses. Fruit as spice; mixed with rice in preparing yeast; leaves for flavouring foods; medicinal as a mild stimulant.

Vern. *Wansui*, *katuntjar*, *ketumbar*, *J, koriander* (Dutch).

Notes. Unripe fruits smell of bugs.

The coriander seeds sold in the markets are stated to have been introduced from India.

## 9. OREOMYRRHIS

ENDL. Gen. Pl. (1839) 787; BUW. Blumea 2 (1936) 172.

Perennial herbs, often caespitose, often pubescent or villose. *Leaves* with sheaths, pinnately dissected, or entire, often all in rosettes. Umbels simple. Involucres many. Calyx teeth inconspicuous. *Petals* entire, imbricate in bud. Disk continuous with the base of the styles. *Fruit* oblong or narrow, slightly laterally flattened, usually tapering towards the end; commissure broad; mericarps subterete, ribs obtuse, prominent, lateral ones close to the commissure; vittae 1 under each groove and usually 2 at the commissure. Carpophore often bipartite.

Distr. Few spp. circum-S.Pacific from Mexico to N. Borneo.

### KEY TO THE SPECIES

1. Leaves compound.
  2. Leaves pinnate to bipinnate; primary leaflets in several pairs. Peduncles 0.7–8 cm. Involucres 2–4 mm. Pedicels 1–9. Fruits 2½–3½ cm . . . . . 1. *O. andicola*
  2. Leaves subnate; lateral leaflets 3–5-partite; terminal leaflet ternate with tripartite segments. Peduncles 12–33 cm. Involucres 5–8 mm. Pedicels 15–30. Fruits 4–6 mm . . . . . 2. *O. papuana*
1. Leaves not compound, linear to narrowly spatulate.
  3. Pedicels 6–8. Fruits 5 by c. 1–1½ mm. Leaves 2–20 cm . . . . . 3. *O. linearis*
  3. Pedicels solitary. Fruits c. 1½ by ¾ mm. Leaves 3–4 mm . . . . . 4. *O. azurellacea*

1. *Oreomyrrhis andicola* HOOK. f. Fl. Antarct. 2 (1844–47) p. 288, t. 101; BUW. Blumea 2 (1936) 173.—*Myrrhis andicola* KUNTH in HUMB. & BONPL. Nov. Gen. & Sp. 5 (1821) p. 13, t. 419.—*Caldasia andicola* DC. Mém. Ombell. (1829) 60.—*Oreomyrrhis colensoi* HOOK. f. Fl. Nov. Zel. 1 (1853–55) 92.—*O. haastii* HOOK. f. Handb. N. Zeal. Fl. (1864) 91.—*O. borneensis* MERR. Am. Journ. Bot. 5 (1918) 515, ic. 36.—*O. pumila* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 63.

Small tufts to spreading soft-haired cushions. Main root fusiform. Caudex with few erect branches bearing one or more rosettes. *Leaves* 0.8–16 cm; sheath 3–30 by 1–3½ mm, tapering into the petiole, margin membranaceous, dorsally glabrous or short-hirsute, inside short-hirsute or sparingly pilose, rather densely ciliate; petiole 0.3–10 cm, canaliculate, glabrous or short-hirsute; lamina ½–4 by 0.4–1.6 cm, triangular-ovate, pinnate to bipinnate, leaflets 5–11, lower ones with 3–5 secondary leaflets, all leaflets pinnatifid to pinna-

tipartite, segments 1–2½ by ¼–½ mm, thinly coriaceous, glabrous or shortly hirsute, sometimes mucronulate, finely ciliate, margins sometimes recurved; small leaflets only with acute, broad-triangular teeth. *Umbels* 1 to several in each rosette; peduncles 0.7–8 cm, terete, densely hairy with spreading somewhat silky hairs, or short hirsute towards the apex, sometimes glabrescent, sometimes exceeding the leaves; involucres 5–10, 2–4 mm, ovate-lanceolate with broad base, outside densely sericeous or shortly hirsute, sometimes finely ciliate; pedicels 1–9, 0–½ mm, to 3 mm in fruit. *Petals* nearly 1 mm, broad elliptic-ovate, base shortly ciliate or glabrous, white or reddish. *Fruits* 2½–3½ by ¾–1¼ by ¾–1½ mm, oblong ovate, somewhat incurved, densely short-hirsute to glabrous.

Distr. Central and S. America from Mexico to the Falkland Islands, moreover in Australia and New Zealand, in *Malaysia*: Br. N. Borneo (Kinabalu) and New Guinea.

Ecol. Open places, rock crevices, alpine grassland, open bogs, among shrubs, 3150–4240 m.

Notes. *Oreomyrrhis andicola* is very polymorphic. In the vast area which it covers it is glabrous to white-tomentose; the height varies from  $1\frac{1}{2}$ –

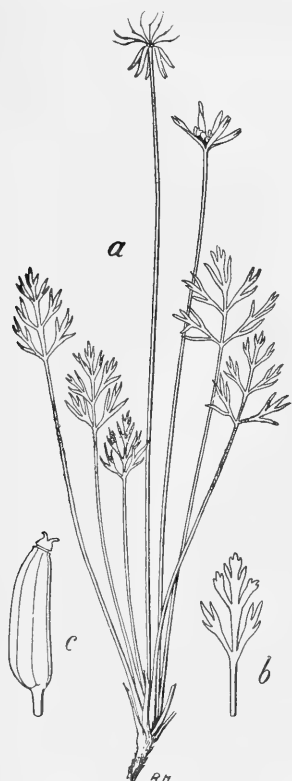


Fig. 6. *Oreomyrrhis papuana* Buw. (plant  $\times \frac{2}{3}$ , fruit  $\times 4$ ).

50 cm; the rosettes are dense or loose bearing simple umbels or slightly branched stems with few leaves and several umbels arranged again nearly in an umbel; the leaves are bi- to tripinnate, rarely simply pinnate with pinnately divided leaflets; the petioles are longer or shorter than the lamina.

**2. *Oreomyrrhis papuana* Buw. Blumea 2 (1936) 175, fig. 5.—Fig. 6.**

Perennial, main root fusiform. Caudex with few erect branches with rosettes. Leaves to 18 cm; sheaths 1–4 by  $\frac{1}{2}$  cm; tapering into the petioles, glabrous, margin scarcely membranaceous; petioles 4–12 cm, canaliculate, subglabrous, apical part subhirsute; lamina  $1\frac{1}{2}$ –2 $\frac{1}{2}$  by 0.8–2 cm, rhomboid-ovate in outline, subternate to pinnate, segments 2–3-partite, ultimate segments to 7 by 1 mm, lanceolate-cuneate to linear-lanceolate, thick-coriaceous, at the thick margin and beneath on the nerves with antrorse bristles. Umbels 1 or more in each rosette; peduncles 12–33 cm, terete, subsul-

cate, towards the apex densely hirsute with small retrorsely appressed bristles; involucre 6–9, 5–8 by 1–2 mm, oblong-spathulate, broad at the base, texture and indumentum as the leaf segments, reflexed in fruit; pedicels 15–30, very short when flowering, to 5 mm in fruit, inner ones shorter, scabrous with short retrorsely appressed bristles. Petals 1–1 $\frac{1}{4}$  by  $\pm \frac{3}{4}$  mm, oblong-ovate or oblong-ovate. Fruits 4–6 by ca  $\frac{3}{4}$  by 1 $\frac{1}{4}$  mm, glabrous. Carpophore undivided.

Distr. Malaysia: W. New Guinea (Central Range).

Ecol. Open swampy, grassy localities, 3200–3500 m.

**3. *Oreomyrrhis linearis* HEMSL. in HOOK. Ic. Pl. 26 (1899) t. 2590; Buw. Blumea 2 (1936) 176.**

Perennial, caespitose. Roots with fibrous branches. Caudex with numerous erect branches, to 12 cm, beset with fibrous leaf rudiments, at the extremities bearing dense or lax rosettes. Leaves 2–20 cm; sheaths 5–35 by 1–4 $\frac{1}{2}$  mm, tapering into the petiole, margin yellowish,  $\frac{1}{2}$  mm; petiole  $\frac{3}{4}$ –1 mm broad, gradually widening to the narrowly linear blade; lamina to 5 mm broad, glabrous or the upper surface retrorsely appressedly hirsute, apical portion on each side 1–4-dentate, margin thickened, in narrow leaves revolute, finely retrorsely ciliate; nervation pinnate, lateral nerves strongly ascending, hardly visible above, strongly prominent beneath. Peduncles 1 to several, 6–30 cm, erect or subcurved, rarely with one leaf, triangular, an-

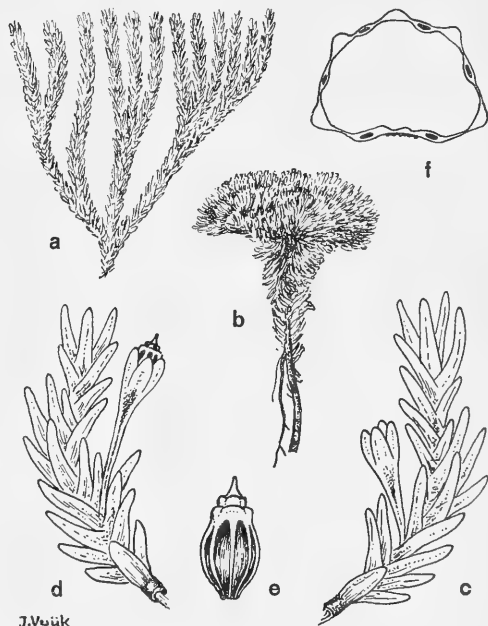


Fig. 7. *Oreomyrrhis azurellacea* Buw. a–b. mode of branching,  $\times 1$ , c–d. flowering and fruiting twigs,  $\times 4$ , e. fruit,  $\times 8$ , f. mericarp in cross-section,  $\times 24$ .



Fig. 8. *Oreomyrrhis azurellacea* BUW., a cushion plant of the alpine grassland on summit of Mt Albert Edward (Papua),  $\pm$  4000 m alt. (BRASS, ARCHBOLD expeditions)

gles subincrassate, retrorsely hirsute towards the apex with appressed whitish bristles to  $\frac{1}{2}$  mm, finally glabrescent; involucre 5–6, 2–5 by  $\frac{1}{2}$ – $1\frac{1}{4}$  mm, lingulate, obtuse, towards the connate base retrorsely hirsute; pedicels 6–8, to  $1\frac{1}{2}$  mm, inner ones sessile, in fruit  $2\frac{1}{2}$ –10 mm, densely retrorsely hirsute. *Petals* 1.1–1.2 by 0.8 mm, violet, triangular. *Fruits* to 5 by nearly 1 by  $\frac{1}{2}$  mm, slightly curved, entirely glabrous.

*Distr. Malaysia*: SE. New Guinea.

*Ecol.* Open sunny localities, open grasslands, grassy creek banks in open country, 3000–3900 m.

#### 4. *Oreomyrrhis azurellacea* n. sp.—Fig. 7–8.

*Species nova glabrata suberecta, habitu maxime ut aliquis species generis Azorella. Faciliter distinguenda caule 3–4 $\frac{1}{2}$  cm longo, foliis 2–4-fariis, densissime imbricatis, 3–4 mm longis, inflorescentia uniflora, pedunculo 2 mm longo, bracteis involucratis 4, pedicello  $\frac{1}{2}$  mm longo, fructu  $1\frac{1}{2}$  mm longo et  $\frac{3}{4}$  mm lato. Forma foliorum valde ad *O. linearis* HEMSL. accedens tamen planta in toto distincte minor.*

A herb, probably perennial, entirely glabrous; stem nearly erect, 3–4 $\frac{1}{2}$  cm long, much branching from the base, branches up to 3 cm long, closely packed and rather stiff, the upper gradually shorter and forming a comparatively dense cushion. *Leaves* very densely imbricate in 2–4 rows, 3–4 mm long, the lower part amplexicaulous and sheathing; sheath appressed, up to 1 mm wide, slightly ciliate

on the pellucid margin and gradually narrowing in the petiole; blade up to  $1\frac{1}{2}$  mm long, up to 1 mm wide, stiffish, coriaceous, spreading, concave, 1-nerved, ciliolate along the submembranaceous margin, tip blunt. *Inflorescences* uniflorous, on top of short branches along the stem, hidden among the foliage during flowering and when in fruit. *Peduncle* 2 mm long, more or less flattened, bracts 4, forming an involucre, spreading, lanceolate,  $1\frac{1}{2}$ –2 mm long,  $\frac{1}{2}$ – $1\frac{1}{4}$  mm wide, connate at the base, suggesting leaves. *Flowers* on up to  $\frac{1}{2}$  mm long pedicels. *Calyx* tube shortly campanulate, laterally slightly compressed, c. 1 mm long,  $1\frac{1}{2}$  mm wide, indistinctly furrowed; teeth absent. *Petals* red, 1 mm long,  $\frac{1}{2}$  mm wide, single-nerved, elliptical, acute. *Stamens* c.  $\frac{1}{2}$  mm long, anthers dorsifix, rounded-ellipsoid, up to  $\frac{1}{2}$  mm long and as wide. *Styles* 2, conical, up to  $\frac{1}{2}$  mm long. *Fruit* c.  $1\frac{1}{2}$  mm long,  $\frac{3}{4}$  mm wide, slightly narrowed near the top and slightly compressed laterally; rims obtuse, equally slightly prominent, beside the commissures, joining near the top of the fruit; stylopodium conical, up to  $\frac{1}{2}$  mm long; mericarp nearly terete.

*Distr. Malaysia*: East New Guinea (Mt Albert Edward, BRASS 4306, type).

*Ecol.* Tiny vivid-green plant occurring in dense pin-cushion masses, common on alpine grasslands, 3680 m alt.

*Notes.* In mode of growth and inflorescence it resembles fallaciously some *spp.* of *Azorella*. How-

ever, it has a parenchymatic endocarp, the vittae are solitary in the furrows and 2 at the commissure; the endosperm is furrowed at the commissure on

cross section. Therefore, it is an *Oreomyrrhis*. Its leaf shape comes very close to *O. linearis*, but it is much smaller in all parts.

## 10. CUMINUM

LINNÉ, Sp.Pl. 1 (1753) 254; BISSCHOP-GREV. Plant. Ned. Ind. (1883) 204; BUW. Blumea 2 (1936) 178.

**1. *Cuminum cyminum*** LINNÉ, Sp.Pl. 1 (1753) 254; BUW. Blumea 2 (1936) 178.

Annual. Stems 15–50 cm, erect, strongly divergently branched from the base, terete, striate, entirely glabrous. *Leaves* short-petioled or sessile on a sheath to 1 by  $\frac{1}{2}$  cm with membranaceous white margins, auriculate at the apex or tapering into the petiole; lamina 3–10 cm, bipinnate, segments to  $1\frac{1}{2}$  mm broad, linear. Compound *umbels* opposite to the leaves or terminal; peduncles 2–4 cm; rays 4–6,  $1\text{--}1\frac{1}{2}$  cm; pedicels 3–7, 4–5 mm; involucre 3–5,  $2\text{--}3\frac{1}{2}$  cm, tripartite or twice tripartite, segments filiform, sessile on a  $\frac{1}{2}$  mm long sheath with membranaceous white margins; involucels 2–4, to 9 mm, margin white-membranaceous. Calyx teeth  $1\text{--}1\frac{1}{2}$  mm, linear to subulate, persistent. *Petals* nearly 1 by  $\frac{1}{2}$  mm, white to reddish, obcor-

date with inflexed tips. *Mericarps* 5–7 by nearly 3 mm, somewhat laterally flattened, main ribs filiform, bristly, ridges with a stellate-hairy line.

Distr. Indigenous in Turkestan, cultivated in all parts of the world; in *Malaysia*: stated to be cultivated in the mountains of Java (HEYNE, OCHSE & BAKH., *ll.cc.*).

Uses. Oil distilled from the seeds for making liqueurs; seeds for seasoning curries; medicinal externally and internally as stomachic and astringent.

Vern. *Djinten putih*, M, *djinten bodas*, S, *djinten poté*, Md, *komijn* (Dutch), *cumin* (Engl.), *Kümmel* (Germ.).

Notes. Description after plants from the Orient; no specimens from *Malaysia* seen by me. The *Cuminum* sold in the markets is stated to have been introduced from India.

## 11. APIUM

LINNÉ, Sp.Pl. 1 (1753) 264; BUW. Blumea 2 (1936) 179.

### KEY TO THE SPECIES

- |  |                          |
|--|--------------------------|
| 1. Leaves pinnate, with broad tripartite to trilobate petiole leaflets . . . . . | 1. <i>A. graveolens</i>  |
| 1. Leaves bi- to tripinnate, with very narrow or filiform segments . . . . .     | 2. <i>A. tenuifolium</i> |

**1. *Apium graveolens*** LINNÉ, Sp.Pl. 1 (1753) 264; BUW. Blumea 2 (1936) 179.

Main root fusiform or tuberiform. Stems 25–90 cm, angular, striate and grooved. Petioles rather long; sheaths to 2 cm in the lower leaves, white-margined; lamina pinnate, leaflets  $2\text{--}2\frac{1}{2}$  by to 3 cm, trilobate to tripartite, petiolulate, in the upper leaves smaller, ternate to 3-partite. Compound umbels opposite the leaves; peduncles 0–2 cm; rays 10–15, 1–3 cm; pedicels 6–10, 2–3 mm; involucre and involucels absent. Calyx teeth absent. *Petals*  $\frac{1}{2}$  mm through, white or greenish, with inflexed tips. *Mericarps* 1 by up to  $\frac{3}{4}$  mm, ribs narrowly winged; stylopodium nearly  $\frac{1}{4}$  mm high, halves conical. Carpophore emarginate.

Distr. Indigenous in the temperate parts of Europe, Africa and Asia, also in S. America, cultivated elsewhere, in *Malaysia*: cultivated from 1–2100 m.

Uses. Leaves, petioles and tuberiform roots for flavouring dishes; seeds as spice and medicinal.

Vern. *Saladri*, S, *celery* (Engl.), *selderie* (Dutch).

**2. *Apium tenuifolium*** THELL. in HEGI, Ill. Fl. Mitteleur. 5, 2 (1926) 1140; BUW. Blumea 2 (1936) 181.—*Sison ammi* (non L. 1753). JACQ. Hort. Vindob. (1773) t. 200 excl. syn. ex THELL. in HEGI *l.c.*—*Cnidium tenuifolium* MOENCH, Meth. (1794) 98, excl. syn.—*Pimpinella leptophylla* PERS. Syn. 1 (1805) 324.—*Helosciadium leptophyllum* DC. Mém. Soc. Phys. Genève 4 (1828) 493.—*Apium leptophyllum* BENTH. Fl. Austr. 3 (1866) 372.—*Apium ammi* URB. in MART. Fl. Bras. 11, 1 (1879) 341, t. 91.

Main root fusiform. Stems 40–50 cm, striate, nearly glabrous. *Leaves* bi- to tripinnate, segments  $\frac{1}{2}\text{--}1$  mm broad, nearly filiform. Compound umbels opposite the leaves; peduncles 0–2 cm; rays 3–5,  $\frac{1}{2}\text{--}1$  cm; pedicels 5–10, 2–4 mm; involucre and involucels absent. Calyx teeth 0. *Petals* nearly 0.4–0.6 by 0.2 mm, with strongly inflexed tips, white. *Mericarps*  $\pm 1\frac{1}{2}$  by  $\frac{1}{2}$  mm, ribs obtusely keeled. Stylopodium bipartite, halves small, conical. Carpophore to  $\pm \frac{1}{2}$  from the apex bipartite.

Distr. Central and S. America, Australia, New Zealand, cultivated and adventive in Europe and Asia, in *Malaysia*: subsontaneous, 700–750 m.

## 12. PETROSELINUM

HILL, Brit. Herbal (1756) 424; BUW. Blumea 2 (1936) 191.—*Carum sect. Petrose-linum* BENTH. & HOOK. f. Gen. Pl. 1 (1879) 891.

**1. *Petroselinum crispum* (MILL.) NYMAN *ex auctt.***  
*Kew* in *Handlist Herb. Pl.* Kew ed. 3 (1925) 122.—  
*Apium petroselinum* LINNÉ, *Sp. Pl.* 1 (1753) 263.—  
*Petroselinum vulgare* HILL, *Brit. Herb.* (1756) 424,  
*ic. p.* 60; BUW. *Blumea* 2 (1936) 182.—*Apium*  
*crispum* MILL. *Gard. Dict.* ed. 8 (1768) no 2;  
 SHAW, *Kew Bull.* (1938) 257; *ibid.* (1939) 168.—  
*Petroselinum hortense* HOFFM. *Gen. Pl. Umbell.*  
 (1814) 163, t. I, 7.—*Petroselinum sativum* HOFFM.  
*op. cit.* 177.—*Carum petroselinum* BENTH. & HOOK.  
*f. Gen. Pl.* 1 (1867) 891.—*Petroselinum petroselinum*  
 KARST. *Fl. Deutschl.* 2 (1895) 394.

Stems 25–100 cm, erect, grooved. Lower leaves  
 to tripinnate, leaflets obovate to cuneate, tripartite;  
 upper leaves ternate. Compound umbels terminal  
 and axillary; peduncles 2–12 cm; rays 5–10, 1–

3 cm; pedicels 3–15, 2–5 mm; involucre 1–3, in-  
 volucre 3–8. Calyx teeth absent. *Petals* nearly 1 by  
 $\frac{1}{2}$  mm, with inflexed tips, greenish yellow. *Meri-*  
*carps* 2–2½ by nearly 1 mm, ribs filiformous.

Distr. Indigenous in S. Europe and N. Africa,  
 cultivated and subspontaneous elsewhere, in *Ma-*  
*laysia*: cultivated up to 2000 m.

Uses. Leaves for flavouring dishes, and as a  
 diuretic.

Vern. *Potrasoli*, M, *parsley* (Engl.), *peterselie*  
 (Dutch).

Notes. According to SHAW the names in HILL's  
 British Herbal are nomenclaturally not eligible  
 since HILL did not accept the binary system of  
 nomenclature in this work.

### 13. TRACHYSPERMUM

LINK, *Enum. Hort. Berol.* 1 (1821) 267; BUW. *Blumea* 2 (1936) 183.—*Carum sect.*  
*Trachyspermum* BENTH. & HOOK. *f. Gen. Pl.* 1 (1867) 891.

#### KEY TO THE SPECIES

1. Leaves 2–3-pinnatisect, the ultimate segments of the lower leaves to 1 mm broad. Calyx teeth distinct.  
 Fruit with broad, roundish, scale-like hairs . . . . . **1. *T. ammi***
2. Leaves 2-pinnatisect, ultimate segments of the lower leaves more than 2 mm broad. Calyx teeth  
 obsolete. Fruit with narrow, obtuse, nipple-shaped hairs . . . . . **2. *T. roxburghianum***

**1. *Trachyspermum ammi* SPRAGUE**, *Kew. Bull.*  
 (1929) 228; BUW. *Blumea* 2 (1936) 183.—*Carum*  
 RUMPH. *Herb. Amb.* 5, p. 270.—*Amudium* RUMPH.  
*lc.*—*Sison ammi* LINNÉ, *Sp. Pl.* 1 (1753) 252.—  
*Ammi copticum* LINNÉ, *Mantissa* 1 (1767) 56.—  
*Ligusticum ajowan* ROXB. *Hort. Beng.* (1814) 21,  
*nomen.*—*L. ajowan* ROXB. *Fl. Ind. ed.* CAREY, 2  
 (1832) 91.—*Trachyspermum copticum* LINK, *Enum.*  
*Hort. Berol.* 1 (1821) 267.—*Ptychotis coptica* DC.  
*Mém. Soc. Phys. Genève* 4 (1828) 496.—*P. ajowan*  
 DC. *Mém. Soc. Phys. Genève* 4 (1828) 497.—*Am-*  
*mi glaucifolium* (non L.) BLCO, *Fl. Filip.* (1837)  
 213.—*Daucus anisodoros* BLCO, *op. cit.* ed. 2  
 (1845) 150, ed. 3, 1 (1877) 269.—*Carum copticum*  
 HIERN, *Fl. Trop. Afr.* 3 (1871) 12.

Stems 25–45 cm, striate, glabrous, usually  
 strongly branched. *Leaves* 2–3-pinnate, ultimate  
 segments to 1 mm broad, narrow-oblong. Com-  
 pound umbels terminal or seemingly lateral; ped-  
 uncles 1–6½ cm; rays 5–9, ½–1 cm, to 2 cm in  
 fruit; pedicels 4–15, 1–6 mm; involucre 3–5, ob-  
 long, sometimes divided; involucre 4–5, oblong;  
 the bracts of both very unequal in length, hirsute  
 with membranaceous margin. Calyx teeth nearly  
 0.2 mm, thickly subulate. *Petals* 0.6–0.7 mm  
 through, obcordate with inflexed tips. *Fruits* to 2  
 by 1 mm, along the ribs with broad scale-like hairs.

Distr. Indigenous and cultivated in Egypt,  
 Abyssinia, SW. Asia to E. India, subspontaneous  
 in Europe, in *Malaysia*: stated to be formerly cul-  
 tivated in Java (HEYNE *lc.*).

Uses. Seeds medicinal as a carminative and in  
 plasters; their medicinal agent is thymol. The seeds  
 sold in the native drugstores are stated to have  
 been introduced from India.

Vern. *Mungsi*, M, *mosé*, Md, *musi* (Bali).

Notes. Description after materials cultivated  
 by HEYNE in his garden.

**2. *Trachyspermum roxburghianum* CRAIB**, *Fl.*  
*Siam. Enum.* 1 (1931) 788; WOLFF, *Pflanzenr.* 90  
 (1927) 129, *nom. altern.*; BUW. *Blumea* 2 (1936)  
 184.—*Apium involucreatum* ROXB. *ex FLEM.* *Ind.*  
*Med. Pl. in As. Research.* 11 (1810) 157.—*Ptycho-*  
*tis roxburghiana* DC. *Prod.* 4 (1830) 109.—*P. in-*  
*volucreatum* ROYLE, *Ill. Bot. Himal.* 1 (1839) 229.—  
*Carum roxburghianum* KURZ, *J. As. Soc. Beng.* 46,  
 II (1877) 114.—*Carum involucreatum* MERR. *En.*  
*Philip. Fl. Pl.* 3 (1923) 239.—*Trachyspermum in-*  
*volucreatum* (non MAIRE, 1922) WOLFF in *Pflanzenr.*  
 90 (1927) 89.

Stems 15–90 cm, striate, subglabrous, usually  
 strongly branched. *Leaves* pinnate; leaflets pinna-  
 tified to pinnatifid, extreme segments to 3 mm  
 broad, those of the upper leaves gradually nar-  
 rower to nearly filiform. Compound umbels  
 terminal and axillary; peduncles 2–8 cm; rays 2–6,  
 1–2½ cm; pedicels 5–15, 2–6 mm; involucre 2–5;  
 involucre 5–8; both very narrow, finely ciliate.  
 Calyx teeth hardly 0.1 mm. *Petals* nearly 1¼ by  
 $\frac{3}{4}$  mm, obcordate with inflexed tips, white or  
 greenish white. *Mericarps* nearly 2½ by ¾ mm,  
 oblong, with very short obtuse spreading hairs.

Distr. Of unknown provenance, now cultivated  
 and subspontaneous in tropical SE. Asia, in *Ma-*  
*laysia*: throughout the Archipelago.

Uses. Raw or steamed eaten with rice; also for  
 flavouring dishes.

Vern. *Renggirung*, *adas*, *djentoa* (Sum.), *suragé*,  
*S, pletikapu*, *J, sorowai* (Halmahera).

## 14. CRYPTOTAENIA

DC. *Mém. Ombel.* (1829) 42; BUW. *Blumea* 2 (1936) 185.

1. *Cryptotaenia canadensis* DC. *Prod.* 4 (1830) 119; BUW. *Blumea* 2 (1936) 185.—*Sison canadense* LINNÉ, *Sp.Pl.* 1 (1753) 252.—*Cryptotaenia japonica* HASSK. *Retzia* 1 (1855) 113.

Rhizome 1–2 by 1 cm, chambered. Stems erect, to 90 cm, terete, striate. *Petioles* to 10 cm, upper ones gradually shorter; sheaths with membranous margins, apex auriculate; lamina ternate, leaflets sessile or short-petiolulate, ovate to rhomboid, irregularly biserrate to bidentate, lateral ones often bifid to bipartite. Compound *umbels* terminal on the stems and the branches, united to leafy panicles; peduncles 1–8 cm; rays 5–7, 3–50 cm, those of one umbel very different in length; pedicels 6–10, 1½–15 mm, those of one umbellule very

different in length; involucre 0–2, to 4 mm, subulate; involucels 2–5, to 1 mm, subulate. Calyx teeth absent, short in fruit. *Petals* nearly 1 by ½–¾ mm, obcordate with inflexed tips, white. *Mericarps* 4–6 by 1½ mm, oblong-ellipsoidal, attenuate at both ends, somewhat laterally flattened, distinctly ribbed; stylopodium conical, bipartite, the halves together with the styles forming nearly ¾ mm long beaks.

Distr. Indigenous in eastern N. America, China and Japan, in *Malaysia*: stated to be cultivated by the Japanese (OCHSE & BAKH., *l.c.*).

Vern. *Salderi djepang*, M.

Notes. Description after materials cultivated in the Bot. Gardens of Buitenzorg and Groningen.

## 15. CARUM

LINNÉ, *Sp.Pl.* 1 (1753) 263; BUW. *Blumea* 2 (1936) 186.—*Carum sect. Carvi* BENTH. & HOOK. *f. Gen. Pl.* 1 (1867) 890.

1. *Carum carvi* LINNÉ, *Sp.Pl.* 1 (1753) 263; BUW. *Blumea* 2 (1936) 186.

Stems to 55 cm, erect, terete, striate. *Petioles* to 13 cm, upper ones gradually shorter, uppermost ones absent, all of them with a sheath with membranous margin and auriculate apex; lamina to 13 by 5 cm, oblong, bipinnate, segments divided. Compound *umbels* terminal to the stems and its branches; peduncles 1–11 cm; rays 5–8, ½–2 cm; pedicels 6–14, 1½–5 mm, to 9 mm in fruit; involucre none or 1, subulate; involucels none. Calyx teeth none. *Petals* to 1¼ by 1 mm, obcordate with short inflexed tips, white. *Mericarps* 4–5 by 1 mm,

often falcate, ribs distinct, yellowish. Stylopodium bipartite, halves low-conical.

Distr. Indigenous in Europe, temperate Asia, cultivated elsewhere, in *Malaysia*: stated to be cultivated in the mountains of Java (MIQUEL, BUWALDA, *l.c.*).

Uses. Seeds in confectionery, also as medicine; oil from the seeds for making liqueur.

Vern. *Karwij* (Dutch).

Notes. Description after European materials, no Malaysian specimens seen by me. The seeds sold in native drugstores are stated to have been introduced from India.

## 16. PIMPINELLA

LINNÉ, *Sp.Pl.* 1 (1753) 263; BUW. *Blumea* 2 (1936) 187.—*Murrithia* ZOLL. *Nat. & Geneesk. Arch.* 2 (1845) 576.—*Heterachaena* ZOLL. *Nat. & Geneesk. Arch.* 2 (1845) 577.—*Anisometros* HASSK. *Flora* 30 (1847) 602.

Annual to perennial herbs. *Leaves* 1–2-pinnate, 1–2-ternate or decomposed, rarely undivided and only dentate. Umbels compound; involucre and involucels few or none. Calyx teeth obsolete or small. *Petals* usually emarginate, often with inflexed tips. Disk continuous with the base of the styles. *Fruits* ovate or broader than long, laterally flattened, usually constricted at the broad commissure; mericarps terete to subpentagonal, often dorsally flattened, ribs slender, obscurely prominent, inner face flat; ridges with 2–3 vittae. Carpophore entire, 2-fid or 2-partite.

Distr. Over 100 *spp.* described from Africa, Europe and continental Asia, in *Malaysia*: Java, Bali, and Luzon.

## KEY TO THE SPECIES

- |   |                        |
|---|------------------------|
| 1. Involucres 3 to more. Lower leaves usually imparipinnate.  |                        |
| 2. Fruits densely warty . . . . .   | 3. <i>P. pruatjan</i>  |
| 2. Fruits hairy . . . . .   | 4. <i>P. ascendens</i> |
| 1. Involucres 1–2. Lower leaves mostly simple.  |                        |
| 3. Lower and middle leaves simple, with serrate margin, not lobed. Umbel rays 20–30   | 2. <i>P. javana</i>    |
| 3. Lower leaves orbicular to reniform, often crenate, sometimes lobate, middle leaves ternate to pinnate with incised leaflets. Umbel rays 8–14 . . . . . | 1. <i>P. anisum</i>    |



Fig. 9. *Pimpinella javana* DC. on Mt Tengger (E. Java), in open *Casuarina junghuhniana* forest. (DE VOOGD)

**1. *Pimpinella anisum* LINNÉ, Sp.Pl. 1 (1753) 264; BUW. Blumea 2 (1936) 187.**

Annual. Stems erect, terete, grooved, pubescent. Petioles of the lower leaves 4–10 cm, upper ones gradually shorter, uppermost leaves sessile, all with membranously margined sheaths, lower lamina cordate, crenate to serrate, subsequent ones successively incised, ternate and nearly pinnate, leaflets dentate to incised. *Umbels* terminal to the stems and its branches; peduncles 2½–7 cm; rays 8–14, 4–25 mm; pedicels 7–13, 1–5 mm; involucre 0–2, 3–4 mm, narrow; involucel 0–2, 1 mm, subulate. *Petals* nearly 1 mm, obcordate with inflexed tips. *Mericarps* to 5 by 2 mm, ellipsoid, short-hairy by antrorse hairs.

Distr. From an unknown provenance, probably from the Orient, cultivated and subspontaneous through the world, especially in the Mediterranean region and Central Europe, in *Malaysia*: stated to be sometimes cultivated in Java (Miq. Fl. Ind. Bat. I, 1 (1856) 740; BISSCHOP-GREV. Plant. Ned. Ind. (1883) 204; KOORD. Exkurs. Fl. Java, 2 (1912) 727; WIGMAN in VAN GORK. O.I. Cult. 2 (1913) 883).

Uses. Fruits carminative and as medicine.

Notes. Description after European materials; no specimens from Malaysia seen by me. The fruits sold in native drugstores are stated to be from India, which gets its supply from Persia.

**2. *Pimpinella javana* DC. Prod. 4 (1830) 122; MOLKENB. in MIQ. Pl. Jungh. (1851) 96, cum var. *macrophylla*, *sylvestri*, *microphylla*; BUW. Blumea 2 (1936) 188.—*Murrithia cordata* ZOLL. Nat. & Geneesk. Arch. 2 (1845) 576.—Fig. 9.**

Stems erect or ascendent, 50–150 cm, terete, striate, shortly and densely hairy, almost tomentose in the youth, later glabrescent. Lower leaves nearly in a rosette; petioles to 10 cm, sheaths 3–6 cm; lamina to 12 by 10 cm, entire, ovate in outline, deeply cordate, subobtusely to acutely serrate; upper leaves gradually smaller and shorter petioled, more acutely serrate or even dentate, uppermost ones with branches in their axils, often tripartite, all of them more or less hairy above, white-tomentose beneath in the youth, glabrescent later. *Umbels* in an oblong panicle, terminal on the stems and its branches or seemingly opposite the leaves; peduncles 4–15 cm; rays 20–30, 2–4 cm; pedicels 12–16, 3–8 mm; involucre 0–4, involucel 1–4, nearly filiform, shorter than the outer pedicels. *Petals* nearly 1½ by 1 mm with small inflexed tips. *Mericarps* nearly 2 by 1 mm, densely hairy with short spreading hairs.

Distr. *Malaysia*: Java (from Mt Sindoro eastward) and Lesser Sunda Islands (Bali).

Ecol. Open or lightly forested localities, between 1200 and 3125 m.



Vern. *Glongong, gembogan, kemboan, sum-pungan, J.*

Notes. *P. javana* is closely allied to the group of allied forms from SE. Asia described as *P. candolleana* W. & A., *P. leschenaultii* CLARKE, *P. pulneyense* GAMBLE, *P. yunnanensis* WOLFF, *P. cam-bodgiana* DE BOISS., *P. coriacea* DE BOISS.; it differs only by its densely hairy fruits which in the above-mentioned species is more or less covered with scale-like papillae.

In Bali I found in a moist locality, some umbels which had produced small roots; this shows the relative value of this character which was used in *P. pruatjan* for specific distinction (v. St.).

**3. *Pimpinella pruatjan*** MOLKENB. in MIQ. Pl. JUNGH. (1851) 97, *cum var. depressa*; BUW. Blumea 2 (1936) 191.—*Heterachaena alpina* ZOLL. Nat. & Geneesk. Arch. 2 (1845) 577.—*Anisometros alpina* HASSK. Flora 30 (1847) 602.—*Pimpinella panatjan* MIRB. ex ROSENTH. Syn. Pl. Diaphor. (1862) 533.—*Carum panatjan* BAILL. Hist. Pl. 7 (1880) 178.—*Pimpinella alpina* (non HOST, 1827); KOORD.-SCHUM. Syst. Verz. I, 1, fam. 228 (1911) 98.—*P. leeuwenii* WOLFF in FEDDE, Repert. 20 (1924) 159.—*P. pruatjan* var. *prolifera* STEEN. Bull. Jard. Bot. Btzg III, 13 (1935) 349.

Perennial. Stems several, 5–50 cm, ascending, sometimes spreading, rooting and forming rosettes, terete, striate, puberulous when young, later glabrescent. *Leaves* mostly in rosettes; petioles to 10 cm; sheaths to 3 cm; lamina imparipinnate, leaflets usually 5, rarely to 11 or only 1, 1–2½ cm, sessile or subsessile, roundly cordate, crenate-serrate to bicrenate-serrate, or slightly lobed; upper leaves shorter petioled and smaller, leaflets less densely incised with narrower more acute segments; all sparingly hairy above, densely so beneath in the youth, later glabrescent. *Umbels* terminal to the stems and branches, often seemingly opposite the leaves; peduncles 1–7 cm; rays 4–8, 7–25 mm; pedicels 4–8, 1–4 mm; involucre 3–6, nearly filiform;

involucels 3–6, nearly filiformous, shorter than the pedicels. *Petals* nearly 1¼ by 1 mm, with inflexed tips. *Mericarps* nearly 2 by 1 mm, warty.

Distr. *Malaysia*: Java (from Mt Pangrango in W. Java to Mt Argapura (Jang) in E. Java).

Ecol. Slightly shaded localities, on grasslands, in *Casuarina*-forests, along pathways and stream-banks, 1800–3300 m.

Uses. Roots medicinal as a diuretic.

Vern. *Antanan kawat, antanan gunung, S, pur-wotjeng, tjumbuan, rumpit demooh, J.*

**4. *Pimpinella ascendens*** DALZ. in HOOK. J. Bot. & Kew Gard. Misc. 2 (1850) 261.—*P. pinetorum* MERR. Philip. J.Sci. 29 (1926) 482; BUW. Blumea 2 (1936) 192.

Perennial herb. stems erect or ascendent, to 40 cm, terete, striate, shortly and densely white-hairy, later glabrescent. *Leaves* in a rosette at the base of the stems and few along the stems; petioles 2–10 cm, sheaths to 12 mm; lamina imparipinnate, leaflets 5–7, 6–15 by 6–18 mm, sessile or subsessile, subcordate to suborbiculate, to truncate; crenate-serrate to bicrenate-serrate; upper leaves shorter petioled and smaller; all densely white-hairy above and beneath. *Umbels* terminal to the stems and its branches; peduncles 11–17 cm; rays 5–6, 11–30 mm; pedicels 4–10, 2–5 mm; involucre 1–2, 4–8 mm; involucels 1–4, 1½–2 mm, shorter than the outer pedicels. *Petals* nearly 1¼ by ¾ mm, with inflexed tips. *Mericarps* nearly 1¾ by 1 mm, sparsely hairy.

Distr. Peninsular India, in *Malaysia*: Philip-pines (Luzon, Benguet, Mt Pulog).

Ecol. Along trails in pine-forest, c. 2000 m alt., locally rather abundant.

Notes. Philippine material is in the herbaria very scarce. According to MERRILL it is in all probability most closely allied to *P. nitakayamensis* HAYATA of Formosa, from which it is at once distinguishable by its indumentum.

## 17. OENANTHE

LINNÉ, Sp.Pl. 1 (1753) 254; BUW. Blumea 2 (1936) 194.—*Sium* sect. *Drepanophyl-lum* BL. Bijdr. 15 (1826) 881.

Glabrous herbs. Roots fusiform or fasciculate-tuberculate. *Leaves* 1–3-pin-nate, ultimate segments large, linear or minute, rarely reduced to sheaths. Umbels compound. Involucres and involucels several, sometimes few or none. Calyx teeth small, acute. *Petals* emarginate, with long inflexed tips, white; outer ones of the inflorescence often enlarged. Disk continuous with the base of the styles. *Fruits* glabrous, ellipsoid or globose, nearly terete; commissure broad; mericarps dorsally flattened, inner face flat; lateral primary ribs broad, corky; dorsal and interme-diate ones often much smaller, sometimes obsolete, seldom all ribs subequal; ridges with 1 vitta. Carpophore 0.

Distr. Some dozens of *spp.* (depending on specific delimitation), mostly in the N. hemisphere, also in S. Africa and trop. Australia.



1. *Oenanthe javanica* DC. Prod. 4 (1830) 138; Buw. Blumea 2 (1936) 194.—*Sium javanicum* BL. Bijdr. 15 (1826) 881.—*Sium laciniatum* BL. Bijdr. 15 (1826) 881.—*Falcaria javanica* DC. Prod. 4 (1830) 110.—*F. laciniata* DC. Prod. 4 (1830) 110.—*Oenanthe stolonifera* DC. Prod. 4 (1830) 138.—*O. linearis* DC. Prod. 4 (1830) 138.—*Dasylooma benghalensis* DC. Prod. 4 (1830) 140.—*Phellandrium stoloniferum* ROXB. Hort. Beng. (1814) 21, *nomen*.—*Oenanthe laciniata* ZOLL. Syst. Verz. (1854) 139.—*Dasylooma javanicum* MIQ. Fl. Ind. Bat. I, 1 (1856) 741.—*Dasylooma laciniatum* MIQ. Fl. Ind. Bat. I, 1 (1856) 741.—*Dasylooma japonicum* MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 59.—*Dasylooma subbipinnatum* MIQ. Ann. Mus. Lugd. Bat. 3 (1867) 59.—*Oenanthe benghalensis* BENTH. & HOOK. f. Gen. Pl. 1 (1867) 906.—*Oenanthe thomsonii* CLARKE in HOOK. f. Fl. Br. Ind. 2 (1879) 697.—*Oenanthe stolonifera* var. *javanica* KUNTZE, Rev. Gen. Pl. 1 (1891) 269.—*Oenanthe schlechteri* WOLFF in SCHUM. & LAUT. Nachtr. Fl. Deut. Schutzgeb. (1905) 333, t. 14.—*O. rivularis* DUNN, J. Linn. Soc. Bot. 35 (1907) 496.

Perennial. Stems 10–100 cm, erect or ascending from a creeping base, terete, ramose. *Petioles* to 10 cm, often with sheaths; lamina pinnate to bipin-

nate, segments ovate, serrate to narrowly oblong, or divided again, this making the leaf 4–5-pinnate. *Umbels* terminal and opposite the leaves; peduncles 1–20 cm, rarely none; rays 5–15,  $1\frac{1}{2}$ –3 cm; pedicels 10–25, 2–5 mm; involucre none or 1; involucre 2–8, 2–4 mm, linear. Calyx teeth nearly  $1\frac{1}{2}$  mm, acute. *Petals* nearly 1 by  $\frac{3}{4}$  mm. *Mericarps* 2–3 by  $1\frac{1}{2}$ –1 mm, ribs swollen, marginal much more than the dorsal ones, the latter if strongly swollen nearly confluent.

Distr. SE. and E. Asia, Formosa, Japan, Queensland, in *Malaysia*: all over the Archipelago.

Ecol. Swampy places, along streams, wet grasslands, and clearings, 1–2800 m, but especially above 1000 m, sometimes cultivated.

Uses. Vegetable, raw or steamed eaten with rice.

Vern. *Lamong*, *selemor*, *shelum* (Mal. Pen.), *batjarongi*, *piopo* (Sum.), *tespong*, *S*, *pambong*, *pampung*, *pangpung*, *matjen* *salade ajer*, *sladri gunung J*, *rukut teleme* (Celebes).

Notes. Very variable as to the dimensions of all its parts, the compoundness of its leaves, the length of the peduncles, the number of pedicels in the umbellules, and the dimensions of the fruits. Many forms formerly described as distinct species; all are connected by intermediates.

## 18. FOENICULUM

ADANS. Fam. Pl. 2 (1763) 101; Buw. Blumea 2 (1936) 200.

1. *Foeniculum vulgare* MILLER, Gard. Dict. ed. 8 (1768); Buw. Blumea 2 (1936) 200.—*Anethum foeniculum* LINNÉ, Sp.Pl. 1 (1753) 263.—*Foeniculum capillaceum* GILIB. Fl. Lithuan. Inchoat. coll. IV (1782) 40.—*F. officinale* ALLIONI, Fl. Pedem. 2 (1785) 25.—*Ozodia foeniculacea* W. & ARN. Prod. (1834) 375.

Perennial, entirely glabrous. Stems erect, to 2 m. Sheaths 4–12 cm in the lower leaves, shorter upwards, apex with cucullate-conate auricles; lamina usually 3–4-pinnate, segments filiform. Compound umbels terminal to the stems and the branches; peduncles 5–16 cm; rays 30–70, 5–7 cm; pedicels 5–30,  $1\frac{1}{2}$ –1 cm; involucre and involucrels

none. Calyx teeth none. *Petals* yellow, strongly curved inward. *Mericarps* nearly 8 by 2 mm, ribs filiformous, nearly equal, not at all winged.

Distr. Indigenous in the Mediterranean region, cultivated all over the world, in *Malaysia*: cultivated throughout the Archipelago, subspontaneous on several mountains in E. Java, common on Mt Tenger (Sand Sea).

Uses. Young leaves and fruits for flavouring dishes; medicinal for giving agreeable flavour to medicines; in European confectionery. The seeds sold in Java are stated to be introduced from India.

Vern. *Adas*, *adas manis*, *J*, *venkel* (Dutch).

## 19. ANETHUM

LINNÉ, Sp.Pl. 1 (1753) 263; Buw. Blumea 2 (1936) 202.—*Peucedanum* sect. *Anethum* BENTH. & HOOK. f. Gen. Pl. 1 (1867) 919.

1. *Anethum graveolens* LINNÉ, Sp.Pl. 1 (1753) 263; Buw. Blumea 2 (1936) 202.—*Anethum sowa* DC. Prod. 4 (1830) 186.—*Peucedanum graveolens* HIERN, Fl. Trop. Afr. 3 (1871) 19.

Annual. Stems 50–100 cm, terete, striate; sheaths  $1\frac{1}{2}$ –2 cm in the lower leaves, shorter upwards, white-margined, apex with cucullate-conate auricles; lamina 3-pinnate, segments filiform. Compound umbels terminal to the stems and its branches; peduncles 4–13 cm; rays 5–15, 2–4 cm; pedicels 5–25,  $1\frac{1}{2}$ –1 cm; involucre and involucrels none. Calyx teeth none. *Petals* yellow, strongly

curved inward. *Mericarps* nearly 5 by 3 mm, more-over with a wing  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm, oblong.

Distr. Indigenous in S. and SW. Asia, cultivated in most parts of the world, in *Malaysia*: cultivated throughout the Archipelago from 10–1050 m.

Uses. Raw or steamed eaten with rice; fruits for flavouring drinks, for native confectionery, in soups, sauces, etc. The fruits sold in Java are stated to be introduced from India.

Vern. *Adas* (Sum.), *walahandji* (Sumba), *djinten*, *adas sowa*, *M*, *dille* (Dutch).



Fig. 10. *Heracleum sumatranum* BUW. (a-c.  $\times 1/2$ , d-f.  $\times 3$ ).

## 20. PASTINACA

LINNÉ, Sp.Pl. 1 (1753) 262; BUW. Blumea 2 (1936) 203.

**1. *Pastinaca sativa*** LINNÉ, Sp.Pl. 1 (1753) 262; BUW. Blumea 2 (1936) 203.

Main root fusiform. Stems angular and strongly grooved. *Leaves* pinnate, leaflets 2–13 by 1–5 cm, oblong-ovate, often 3-lobate to 3-partite, irregularly crenate. Compound umbels terminal on the stems and its branches; peduncles 3–7 cm; rays 5–12, 1–4 cm; pedicels 10–20, 2–7 mm; involucre and involucels none or 1–2. Calyx teeth none.

*Petals* yellow, with inflexed tips. *Mericarps* inclusive the  $1/4$ – $1/2$  mm broad marginal wing 5–7 by 4–5 mm, broad-elliptic.

Distr. Spontaneous in Europe and temperate Asia, elsewhere cultivated and subsontaneous; in Malaysia cultivated in W. Java, ca 900 m.

Uses. Medicinal as a diuretic.

Notes. Description after European materials; Malaysian specimens scanty.

## 21. HERACLEUM

LINNÉ, Sp.Pl. 1 (1753) 249; BUW. Blumea 2 (1936) 204.

Perennial or biennial herbs, seldom glabrous. *Leaves* broad-lobate to tripinnate, rarely ternately dissected, segments broad. Umbels compound with many rays. Involucres few or 0, simple, rarely many; involucels many, rarely divided. *Flowers* polygamous, often radiating, white or yellowish. Calyx teeth obsolete, seldom small, linear, lanceolate. Petals obovate, cuneate-rhomboid or unguiculate, emarginate to 2-fid with inflexed tips. Ovary hairy or pubescent. *Fruits* orbicular-obovate or elliptical, strongly dorsally flattened; dorsal and intermediate ribs thin-filiformous, lateral ribs usually with a broad wing; vittae usually solitary in each ridge, as long as the mericarps or abbreviated and dilatated below. Carpophore 2-partite.

Distr. Over 70 spp. confined to the N. hemisphere.

**1. *Heracleum sumatranum*** BUW. Blumea 2 (1936) 204, fig. 6.—Fig. 10.

Stems probably erect, striate or subsulcate, upwards more or less hirsute, incrassate at the nodes; internodes 20–55 cm, upwards shorter. *Leaves* few, with small rosettes in the axils, sessile on a sheath. Sheaths 40 by 15 mm, amplexicaulous, margins membranous, tips auriculate or narrowed. Lamina to 20 by 28 cm, deltoid in outline, biternate to ternate; terminal leaflet with a to 10 cm long petiole, tripartite or ternate; lateral ones with to  $3\frac{1}{2}$  cm long petioles; petioles of the secondary and tertiary leaflets gradually shorter to 0; leaflets oblong-ovate, long-acuminate, all serrate to biserrate with short-acuminate apiculate teeth, beneath thin-hirsute on the nerves. *Peduncles* 10–20 cm; involucre none; involucels 6–7 by circa  $\frac{1}{2}$  mm, lanceolate, long-acuminate, somewhat hirsute with narrow, membranous margin; rays 9–12,  $1\frac{1}{2}$ –3 cm, sulcate, shortly hirsute, to 4–6 cm in fruit, spreading, reflexed later; pedicels to 20, 2–5 cm, densely

thin-hirsute, to 8–12 cm in fruit, spreading, later reflexed. Calyx teeth inconspicuous or to  $1\frac{1}{4}$  mm in the marginal flowers. *Petals* of the central flowers to  $1\frac{1}{2}$  by 1 mm, elliptical to obovate, inflexed tip 1 mm; marginal flowers radiating, outer petals to 3 by 4 mm, broad-obcordate. *Mericarps*  $6\frac{1}{2}$ –8 by  $5\frac{1}{2}$ –7 mm, roundly ovate, glabrous, with a  $2\frac{1}{2}$  mm broad wing; marginal ribs  $\frac{1}{2}$  mm from the margin, vittae transversely septate.

Distr. *Malaysia*: Central Sumatra (Mt Singalang).

Ecol. Mountain forests, 2400 m.

Notes. Closely allied to the group enumerated in the Fl. Br. Ind. from *H. wallichii* DC. to *H. barmanicum* KURZ. As these species show only slight differences, and *H. sumatranum* BUW. differs more from them than these species *inter se*, it is maintained as a different species; however, it might perhaps be better to unite them all to one polymorphic species.

## 22. PEUCEDANUM

LINNÉ, Sp.Pl. (1753) 244.

Often robust herbs, root fusiform, sometimes tuberous. *Leaves* pinnate. *Flowers* bisexual, upper ones sometimes ♂, white or yellow, rarely purple. Compound umbels without involucres. Involucels present. Calyx rim abbreviate, shortly or distinctly toothed. Petals broad-ovate, with a long, inflexed tip. Stylopodium thick-conical, surrounded by the calyx rim. *Fruit* strongly dorsally compressed, narrow- to broad-elliptic, sometimes emarginate; marginal wings coherent, loosening when the meri-



Fig. 11. *Peucedanum japonicum* THUNB. Basal leaf and flowering stem,  $\times \frac{1}{2}$ , mericarps,  $\times 5$  (SIEBOLD H.L.B. 908. 260.-495), root,  $\times \frac{1}{2}$  (MAXIMOVICZ Iter 2, H.L.B. 908. 260.-483).

carps are ripe. Mericarps rather thin and slightly concave, with a distinct marginal wing in the base of which the marginal ribs are merging; dorsal side with 3 distinct ribs; vittae narrow, 1–3 between the ribs and 2–6 at the commissure. Carpophore split to the base, filiform.

Distr. Large polymorphous genus, sometimes split into several genera formerly recognized as sections, about 200 *spp.*, centering in the Orient, NE. Africa and W. North America, not or scarcely in S. America and absent in Australia, in *Malaysia* only known from the islands N of Luzon.

**1. *Peucedanum japonicum* THUNB.** Fl. Jap. (1784) 117; HAYATA, Ic. Pl. Form. 2 (1912) 57; MERR. Philip. J.Sc. 30 (1926) 418.—**Fig. 11.**

Taproot elongated fusiform, apex with erect remnants of sheath nerves 1 cm long; flowering parts puberulous otherwise glabrous. Stem terete, grooved, slightly flexuose, erect, often branched,  $1/2$ – $3/4$  cm diam., solid, 15–100 cm tall. Branches with distinct nodes, alternate, rather erect. Basal leaves in large specimens long-petioled with 3 bi-jugate, long-stalked, ternate segments, blade c. 30–40 cm diam.; leaves of small specimens and flowering stems much smaller, 7–10 cm diam., biternate; petiole 3–5 cm sheathing over its entire length, amplexicaulous at the base, striate; lateral segments  $1/2$ –2 cm petiolulate, terminal ones  $1 1/2$ –4 cm, all 3-parted; leaflet-segments sessile, often connate at the base, lateral ones oblique, all obovate-cuneate, margins entire, apex broadened 3–5-toothed or -lobed, lobes often dentate, about equal in size  $2 1/2$ –4 by 1–3 cm; uppermost leaves reduced. Inflorescence corymbiform. Compound umbels terminal, 4–7 cm wide; peduncle 6–7 cm, in fruit to 10 cm, stout, striate, erect. Rays 15–25, unequal in length,  $1/2$ – $2 1/2$  cm. Involucres 0. Secondary peduncles in flower 1–2, in fruit 2–3 cm long, hardening. Involucres 7–10, subequal or very unequal, lanceolate-oblong, acute, 2–6 mm. Pedicels 17–20,

in flower 1–2 and 4–5 mm, outer largest, in fruit hardening but not elongating. *Flowers* not radiant. Calyx indistinct. Petals ? white, c.  $1 1/4$  by 1 mm, emarginate through inflexed tip. Stamens inflexed in bud; filaments 2 mm. Stylopodium blunt, very thick, cap-like covering tip of ovate ovary and as broad as it, margin crenate. Styles 2, exceedingly short. *Fruit* partly abortive, 5–6 by  $2 1/2$ –3 mm, elliptic, crowned by the stylopodium. Mericarps dehiscing from the base, pendent from the filiform carpophore halves, minutely puberulous to subglabrous, marginal wing ca  $1/3$ – $1/2$  mm broad, ventral side rather flat, through wing subconvex; body darkish, wings and ribs pale brown (description after Japan. specimens in Rijksherbarium).

Distr. Japan, Taiwan, in *Malaysia*: Philippines (Batan Islands, N of Luzon: Sabtan Island, MERRILL 11755, not seen).

Ecol. In crevices of cliffs along the seashore.

Notes. The insertion of this species is wholly on Dr MERRILL's authority who collected and identified it. His identification was checked with the late Dr HAYATA while the late Dr JUEL compared a fragment with THUNBERG's type. The only difference with the type was that the Philippine specimen was glabrous. By Ind. Kew. it is wrongly reduced to *Ligusticum acutifolium*, an error for *L. acutlobium* S. & Z. (v. St.).

## 23. DAUCUS

LINNÉ, Sp.Pl. 1 (1753) 242; BUW. Blumea 2 (1936) 207.

**1. *Daucus carota* LINNÉ**, Sp.Pl. 1 (1753) 242; BUW. Blumea 2 (1936) 208.

Annual, biennial or perennial. Main root fusiform. Stems erect, striate or grooved, hirsute. Leaves 2–3-pinnatipartite, segments lanceolate. Compound umbels with flat or round surface when flowering, with incurved peduncles and pedicels and hollow surface in fruit; peduncles 2–25 cm; rays 15–30, 1–6 cm; pedicels 20–30,  $1/2$ – $1 1/2$  cm; involucres 3–5 cm, pinnatipartite, white-margined towards the base; involucres 5–7,  $1/2$ –2 cm, entire to pinnatipartite, lanceolate. Calyx teeth  $1/4$ – $1/2$  mm, triangular, acute. *Petals* white or dark red in 5–7 central sterile flowers of the central umbel,

with inflexed tips, peripheric ones radiating. *Mericarps* 3 by  $1 1/2$ –2 mm, nearly oblong; primary ribs filiform with rather few nearly  $1/4$  mm long, fine bristles, secondary ribs beset with nearly 1 mm long, rigid bristles.

Distr. Spontaneous in Europe, N. Africa, and temperate Asia, cultivated in all parts of the world, in *Malaysia*: cultivated from 0–1800 m, subspontaneous on grassy mountain sides.

Uses. Roots as vegetable, young leaves raw or steamed eaten with rice.

Vern. *Boktel*, *S, peen*, *wortelen* (Dutch), *carrot* (Engl.).

## Excluded & doubtful

*Conium maculatum* L.; BOERL. Handl. 1, 2 (1890) 616. This species has never been found in *Malaysia*.

*Hydrocotyle monopetala* BLCO, Fl. Filip. (1837) 213. MERRILL places this with doubt in *Ophiorrhiza* (Rub.), cf. En. Philip. Fl.Pl. 3 (1923) 502.

*Hydrocotyle nuanavoides* F.v.M. Bot. Centr. Bl. 1 (1892) 194, *nomen*. New Guinea.

*Hydrocotyle villosa* (non L. f.) KOORD. Teysmannia 11 (1901) 252. Prob. a writing mistake; *H. villosa* L. f. is a native of S. Africa.

## DILLENIACEAE (R. D. Hoogland, Leyden)

Trees, shrubs, lianas or perennial herbs. *Leaves* spirally arranged, opposite in one species only (Madagascar). Blade simple or, rarely, (only in *Acrotrema*) to threefold pinnatisect. Stipules absent, but in *Acrotrema* and a number of species of *Dillenia* petiole with stipule-like, often wholly or partly caducous wings. Inflorescence cymose or racemose, sometimes reduced to a single flower, terminal or axillary. *Flowers* ♂, actinomorphic to (mainly in the androecium) zygomorphic, hypogynous, mostly yellow or white. Sepals (3-) 4-5 (-20), imbricate, persistent in fruit. Petals (2-) 3-5 (-7), caducous usually within half a day after opening of the flower, imbricate in bud, all equal, apex rounded or emarginate. Stamens  $\infty$ -3, often partly staminodial, free or partly coherent by their filaments, centrifugal. Anthercells basifix, oblong to linear, opening with an apical pore or a longitudinal slit. Carpels  $1 \pm 20$ , free or connate along the central axis only, with free styles. Ovules  $\infty$ -1, anatropous, apotropous, on an axile placenta. *Fruit* dehiscent or indehiscent, in the latter case permanently enclosed by the sepals. Seeds arillate or with a rudimentary aril, with abundant endosperm and a minute, straight embryo.

*Distr.* Ca 10 genera, of which one circumtropical (*Tetracera*), 3 confined to tropical S. America, one in the Old World tropics from Madagascar to the Fiji Islands (*Dillenia*), one endemic in Ceylon (*Schumacheria*), one in S. India, Ceylon, and the Malay Peninsula (*Acrotrema*, fig. 5), one endemic in Borneo (*Didesmandra*), one endemic in Australia (*Pachynema*), and one on the southern hemisphere from Madagascar to the Fiji Islands, mainly in Australia (*Hibbertia*, fig. 3). Many species are relatively limited in distribution, none is distributed throughout Malaysia.

*Ecol.* Most Malaysian species occur in primary or secondary evergreen forests. A few deciduous species of *Dillenia* are found in monsoon forests or in savannahs, some *Tetraceras* in open vegetation and thickets and both species of *Hibbertia* in open scrub.

In size *Hibbertia* shows the biggest development among the genera with over 100 *spp.*, next in sequence are *Dillenia* with ca 55 *spp.* and *Tetracera* with over 30 *spp.* Most representatives are found in the everwet parts of the tropics, but the ability of the family to produce drought-resistant forms is distinctly shown by various xerophilous species of *Hibbertia* and *Pachynema*, showing remarkable adaptations and reductions in foliage and habit.

As to altitudinal distribution the tropical representatives are generally confined to the tropical zone proper, i.e. below 1000 m. Exceptions are *Hibbertia scandens*, found both at low altitude in the Aru Islands and at ca 2300 m on Mt Arfak, and some species of *Dillenia*, which may occasionally be found up to 1800 m.

*Notes.* A more extensive treatment of *Dillenia*, including all extra-Malaysian species, will be published in Blumea vol. 7, a similar treatment of *Tetracera* for Asia, Malaysia, Australia, and the Pacific will be published in Reinwardtia vol. 1. Latin diagnoses of new taxa will be given there.

Additional species of *Hibbertia*, and possibly also of the other Australian genus *Pachynema*, can be expected to be found in favorable localities in the extreme Eastern part of Malaysia.

For a proper identification of *Dilleniaceae* it is of primary importance to have flowering material, fruits is less important. Sterile material is almost worthless.

### KEY TO THE GENERA

1. Receptacle flat. Carpels completely free or loosely coherent along their adaxial side.
  2. Stamens  $\infty$ , free.
    3. Anthercells parallel, connective linear.
      4. Small perennial herbs. Petiole with amplexicaul wings . . . . . 3. *Acrotrema*
      4. Small shrubs or climbers. Leaves clasping, but not completely amplexicaul . . . . . 2. *Hibbertia*
    3. Anthercells diverging towards the base, connective broadened . . . . . 1. *Tetracera*
  2. Androecium consisting of 2 groups, each of 1 stamen and 4 staminodes with coherent filaments
    4. *Didesmandra*
1. Receptacle between the carpels conical. Carpels distinctly coherent along their adaxial side
  5. *Dillenia*

### 1. TETRACERA

LINNÉ, Sp. Pl. (1753) 533; Gen. Pl. ed. 5 (1754) 237.—*Delima* LINNÉ, Gen. Pl. ed. 5 (1754) 231.—*Assa* HOUTT. Nat. Hist. 5 (1776) 275.—*Wahlbomia* THUNB. Vet.

Akad. Handl. Stockh. (1790) 215.—*Eleiastis* RAFIN. Sylva Tellur. (1838) 165.—*Delimopsis* MIQ. Fl. Ind. Bat. 1, 2 (1859) 9.

Shrubs, sometimes straggling, or lianas. *Leaves* simple, often scabrid on one or both sides. Petiole short, furrowed. Panicles axillary or terminal, few- to many-flowered. *Flowers* actinomorphic, fragrant. Sepals 4–5, persistent, often reflexed when in fruit. Petals 3–5, caducous, with emarginate apex, whitish or slightly reddish. Stamens  $\infty$ , with broadened connective, thereby anthercells divergent towards the base. Carpels 1–4, free, with a short style, ending in a simple stigma, with 4–20 ovules. *Capsule* coriaceous, opening with 1–2 longitudinal slits, ovoid with a short beak, one- to few-seeded. Seed glossy dark brown to black. Aril fleshy, cup-shaped, reddish or purplish, enveloping at least the base of the seed, equal- or unequal-sided with fimbriate or laciniate apical margin.

**Distr.** The only pantropical genus in the family, absent, however, from the Pacific area except New Caledonia. The Malaysian species are confined to the Asiatic-Australian region. There are two local endemics, viz *T. maingayi* HOOGL. in the Malay Peninsula and *T. lanuginosa* DIELS in New Guinea. The other Malaysian species have rather large areas.

**Ecol.** Lianas in rain-forests, on forest margins and in hedges; some species occur as shrubs in open country. Usually below 500 m alt., rarely up to 1300 m. None of the Malaysian *spp.* shows a distinct flowering-time.

**Vern.** The Malay name *ampalas* (*ampēlas*, *ēmpēlas*, *mēmpēlas*, *mumplas*) is in use throughout W. Malaysia for the whole genus, some species being distinguished by epithets. *Akar* = root or liana is also found in a number of combinations.

**Uses.** The scabrid leaves of some species are used as a substitute for sandpaper; the Malay name for sandpaper has been derived from the plantname: *mēmpēlas*. The stems can be used as cordage.

**Notes.** The genus *Delima* L., still kept apart by RIDLEY (Fl. Mal. Pen. 1, 1922, 3), is included here in *Tetracera*, as has been done already by VAHL (Symb. Bot. 3, 1794, 70). GILG & WERDERMANN (in ENGL. & PR. Nat. Pfl. Fam. 2nd ed., 21, 1925, 18) retain *Delima* as a section of *Tetracera*. It should be noted, however, that the differences between *Delima* and *Eutetracera* are only found in the number of carpels, being 2–6 in *Eutetracera*, 1 in *Delima*, usually however on the same plant in a number of flowers 2. Of the 4 Malaysian species, belonging to the section *Delima*, 2 show close relationships to species belonging to the section *Eutetracera*, viz *T. glaberrima* MARTELLI to *T. akara* (BURM. f.) MERR. and *T. maingayi* HOOGL. to *T. fagifolia* BL. *Delima* can be retained as a section on practical grounds only; it does not form a natural taxon.

#### KEY TO THE SPECIES

1. Carpels 1, in a few flowers on the same plant 2 (section *Delima*).
  2. Carpels and fruit hirsute . . . . . 1. *T. scandens*
  2. Carpels and fruit glabrous or with minute scales.
    3. Inflorescence up to 5-flowered, usually axillary. Flower *ca* 2½ cm diam. Sepals 4 . . . . . 2. *T. glaberrima*
    3. Inflorescence at least 15-flowered, terminal. Flower *ca* 1–1½ cm diam. Sepals 5.
      4. Sepals glabrous inside . . . . . 3. *T. asiatica*
      4. Sepals sericeous inside . . . . . 4. *T. maingayi*
1. Carpels 2–4 (section *Eutetracera*).
  5. Carpels and fruit hairy over the whole surface.
    6. Indumentum of the carpels consisting of rather thin villose hairs, caducous. Species from W. Malaysia . . . . . 12. *T. arborescens*
    6. Indumentum of the carpels consisting of rather rigid, persistent, straight hairs. Species from E. Malaysia.
      7. Hairs of the carpels *ca* 2 mm long. Inflorescence 2–4-flowered . . . . . 5. *T. lanuginosa*
      7. Hairs of the carpels *ca* ½ mm long. Inflorescence 15–50-flowered . . . . . 6. *T. nordtiana*
  5. Carpels and fruit glabrous or with minute scales or with few rigid hairs on the back only.
    8. Sepals 4. Inflorescence up to 12-flowered, terminal or axillary, without leaves in the basal part. Flower *ca* 2½–3 cm diam.
      9. Sepals glabrous inside . . . . . 7. *T. indica*
      9. Sepals sericeous inside . . . . . 8. *T. akara*
    8. Sepals 5–6. Inflorescence at least 15-flowered, rarely less-flowered, terminal, often with small leaves in the basal part, or axillary, but then always on a few-leaved branch. Flower *ca* 1–2½ cm diam.
      10. Sepals glabrous inside.
        11. Branches of the inflorescence strigose, without stellate groups of shorter hairs. . . . . 9. *T. loureiri*
        11. Branches of the inflorescence with single strigose to hirsute hairs, together with stellate groups of shorter hairs . . . . . 10. *T. korthalsii*

10. Sepals, at least the 3 inner ones, sparsely to densely sericeous inside.

12. Two outer sepals glabrous inside . . . . . 11. *T. macrophylla*

12. All sepals sericeous inside.

13. Younger branches villose. Leaves under the inflorescence small (ca 4 by 3 cm), obovate.

12. *T. arborescens*

13. Younger branches strigose. Leaves under the inflorescence larger, elliptic to oblong.

13. *T. fagifolia*

1. *Tetracera scandens* (L.) MERR. Int. Rumph. (1917) 365; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 2.—*Funis urens aspera* RUMPH. Herb. Amb. 5 (1747) 13, t. 9.—*Tragia scandens* L. in STICKM. Herb. Amb. (1754) 18; AMOEN. Acad. 4 (1759) 128.—*Delima sarmentosa* L. Syst. ed. 10 (1759) 1076; MIQ. Fl. Ind. Bat. 1, 2 (1859) 7; VILLAR, Nov. App. (1880) 2; RIDL. Fl. Mal. Pen. 1 (1922) 3.—*Tetracera sarmentosa* VAHL, Symb. Bot. 3 (1794) 70; ROXB. Fl. Ind. ed. CAREY 2 (1832) 645, p.p.; BLANCO, Fl. Filip. ed. 2 (1845) 320; op. cit. ed. 3, 2 (1878) 227; MERR. Govt Lab. Publ. Philip. 27 (1905) 15.—*Delima hebecarpa* DC. Syst. 1 (1818) 407; DELESS. Ic. Sel. Pl. 1 (1821) t. 72.—*Delima intermedia* BL. Bijdr. 1 (1825) 4; HASSK. Pl. Jav. Rar. (1848) 176.—*Delima frangulaefolia* PRESL, Rel. Haenk. 2 (1835–6) 73; VILLAR, Nov. App. (1880) 2.—*Delima aspera* BLANCO, Fl. Filip. (1837) 429; op. cit. ed. 2 (1845) 299; op. cit. ed. 3, 2 (1878) 191, t. 190.—*Tetracera monocarpa* BLANCO, Fl. Filip. (1837) 459.—*Delima sarmentosa* var. *hebecarpa* HK. f. & TH. Fl. Ind. 1 (1855) 61; MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 618; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 73; HK. f. & TH. Fl. Br. Ind. 1 (1872) 31; KING, J. As. Soc. Beng. 58, 2 (1889) 362.—*Delima sarmentosa* var.  $\beta$  MIQ. Fl. Ind. Bat. 1, 2 (1859) 7.—*Tetracera sarmentosa* var. *hebecarpa* MARTELLI in BECC. Malesia 3 (1886) 150; VIDAL, Rev. Pl. Vasc. Filip. (1886) 36.—*Tetracera hebecarpa* BOERL. Cat. Hort. Bog. (1899) 3; BACK. Fl. Batavia 1 (1907) 4; Schoolfl. Java (1911) 8; KOORD. Exk. Fl. Java 2 (1912) 600.—*Tetracera volubilis* MERR. Spec. Blanc. (1918) 362, *sphalm.*, non L.—*Tetracera scandens* var. *hebecarpa* HEYNE, Nutt. Pl. (1927) 1070.—*Delima scandens* BURK. Dict. (1935) 776.

Liana (up to 30 m) or small shrub (up to 2 m). Leaves oblong to obovate, ca 6–15 by 3–7 cm, scabrid, apex and base rounded to obtuse. Petiole ca 6–12 mm. Inflorescence terminal, many-(up to ca 200)-flowered, with in the basal part 1–5 leaves, up to ca 40 by 20 cm. Flower ca 6–8 mm diam. Sepals 4, on the same plant in some (ca 5%) of the flowers 5, ca 3 by 2 mm, scabrid outside. Petals 3. Stamens 3 mm long; anthercells reaching each other at the apex. Carpels with 0.4–0.7 mm long rigid hairs; ovules ca 10. Capsule ovoid, ca 10 by 6 mm, 1(–2)-seeded. Seeds 4 by 3 mm. Aril 2–3 mm long, fimbriate for  $\frac{3}{4}$ – $\frac{9}{10}$  of its length.

Distr. S. China (Yunnan), Burma, S. Siam, S. Indo-China, Andaman Islands, in Malaysia: throughout W. Malaysia, not E of the Philippines, Celebes and the Lesser Sunda Islands (Flores).

Ecol. Creeper or climber in thickets and secondary forests, especially on riverbanks and near the seacoast; in more open vegetation forming small shrubs. From sea-level up to 1000 m, rarely above 500 m.

Vern. Sumatra: *akar ampala* (Priaman), *a. (rēm)pēlas* (Palemb.), *baik sipi hendak* (Lamp.), *galinggin* (Asahan), *hasahan* (Lamp.), *mēmpēlas padang* (Bengkalis), *ompe* (Atjeh). Malay Peninsula: *akar mēmpēlas hari bētina*, *a. m. tikus*, *a. m. puteh*, *a. pēlah*, *ampēlas hari (bētina)*, *a. puteh*, *a. kasap*, *a. rimau*, *a. tikus*. Java: (*akar*) *mēmpēlas hari bētina*, *a. m. ojad*, *a. m. putih*, *a. m. tikus*, *kaju as(s)ahan*, *ki asahan* (Mal.); *areuj ki assahan lalaki*, *a. ki assahan*, *ki asahan*, *asahan areuj*, *kroko ojad* (Sund.); *bo*, *dēbo*, *dēmbo*, *kroko*, *ojal*, *roko*, *rokan*, *singaran* (Jav.). Kangean: *ampēlas*. Borneo: *agupit* (Bajau), *akar ampalas*, *ampalas* (Malay), *kērūb kērūb* (Bajau), *panpan* (Sungei). Philippines: *dangilian* (Bag.), *malakatmon* (Tag., Pamp.), *malbastigbalang* (Tag.), *pakiling* (Sbl.). Celebes: *lumpiwi apaēlaē*. Bali: *bun api-api*.

Uses. The leaves are used for polishing wood and metal. The stems may be used as cordage. Medical use is unimportant, cf. BURKILL, l.c.

Notes. The glabrous-fruited form, described as *Delima sarmentosa* var. *glabra* by HK. f. & TH. Fl. Ind. 1 (1855) 61 is considered here as a separate species; cf. *T. asiatica* (LOUR.) HOOGL.

2. *Tetracera glaberrima* MARTELLI in BECC. Malesia 3 (1886) 150.

Scandent shrub. Branches glabrous. Leaves elliptic to obovate, ca 5–9 by 2–4 cm, rather coriaceous, bright glossy green above, not scabrid, with acuminate apex. Petiole 3–8 mm. Inflorescence axillary, 1–5-, usually 3-flowered. Flower ca 2½ cm diam. Sepals ca 9 by 6 mm, glabrous to sparsely sericeous inside. Petals 4. Stamens 5 mm long; anthercells reaching each other at the apex. Carpels with ca 10 ovules. Capsule ovoid, ca 15 by 10 mm with a 2–3 mm long beak, 1–3-seeded. Seeds 3–4 by 2–3 mm. Aril 5 mm long, lacinate to about halfway its length.

Distr. Malaysia: Borneo (Kuching); has been cultivated in the Botanic Gardens at Bogor.

Notes. The species is most closely related to *Tetracera akara* (BURM. f.) MERR., from which it differs by the single carpel, the less densely sericeous inside of the sepals, and the relatively broader leaves.

3. *Tetracera asiatica* (LOUR.) HOOGL. comb. nov.—*Seguieria asiatica* LOUR. Fl. Coch. (1790) 341.—*Delima sarmentosa* (non L.) BURM. f. Fl. Ind. (1768) 122, t. 37; DC. Syst. 1 (1818) 407; Prod. (1824) 69; TRIM. Handb. Fl. Ceyl. 1 (1893) 5.—*Tetracera sarmentosa* (non VAHL) ROXB. Fl. Ind. ed. CAREY 2 (1832) 645, p.p.—*Leontoglossum scabrum* HANCE in WALP. Ann. 2 (1851) 18.—*Delima sarmentosa* var. *glabra* HK. f. & TH. Fl. Ind. 1 (1855) 61; HK. f. & TH. Fl. Br. Ind. 1 (1872) 31.—*Delimopsis hirsuta* MIQ. Fl. Ind. Bat. 1, 2 (1859) 10; Suppl. 1 (1860)



152, 618.—*Delima sarmentosa* f. *hirsutior* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 73.—*Tetracera hirsuta* BOERL. Cat. Hort. Bog. (1899) 3.—*Tetracera levinei* MERR. Philip. J. Sc. Bot. 8 (1918) 147.—*Tetracera scandens* (non MERR.) MERR. Lingn. Sc. J. 5 (1927) 128.—*Davilla hirsuta* TEYSM. & BINN. ms.

Small shrub (to 3 m) or liana (to 12 m) with scabrid branches. *Leaves* oblong, 6–12 by 3–5½ cm, scabrid. *Petiole* 5–10 mm. Inflorescence terminal, 30–150-flowered, in the basal part often with 1–4 leaves, 10–25 by 5–15 cm; branches scabrid. *Flower* ca 8–10 mm diam. *Sepals* 5, the outer two 2 by 1½ mm, the inner three 4 by 3 mm, scabrid outside. *Petals* 3. *Stamens* 3–4 mm long; anthercells slightly separated at the apex. *Carpels* with ca 10–12 ovules. *Capsule* ovoid, ca 6–10 by 4–6 mm with a 2–5 mm long beak, 1(–2)-seeded. *Seeds* 4 by 3 mm. *Aril* 5 mm long, fimbriate for 1½–2/3 of its length.

*Distr.* Ceylon, Assam, Bengal, Andaman Islands, E. Siam, Indo-China, S. China, in *Malaysia*: Sumatra, Malay Peninsula, and ?Borneo.

*Notes.* The species has been separated from *Tetracera scandens* (L.) MERR., in which it has been included until now as a glabrous-fruited variety, as it appeared that the difference in the carpel is connected with the number of sepals. The calyx in *T. scandens* is tetramerous, only in a few flowers on the same plant pentamerous, in *T. asiatica* it is in all flowers pentamerous.

Within the species 4 subspecies can be recognized. They differ in the shape of the leaf, but the most characteristic and constant difference is found in the structure of the indumentum. As to this character no intermediate forms have been found. The 2 extra-Malaysian subspecies are geographically isolated; these are *ssp. zeylanica* HOOGL. in Ceylon, and *ssp. asiatica* in E. Siam, Indo-China and S. China (Kwangsi, Kwangtung and Hainan). The areas of the two Malaysian subspecies overlap in the Malay Peninsula.

*ssp. andamanica* HOOGL. *ssp. nov.*

Young branches sparsely strigose together with sparsely to profusely distributed divergent tufts of ca 3–12 shorter (0.3–0.5 mm long) hairs; branches of the inflorescence similar. *Leaves* generally narrower than in the second Malaysian subspecies, with acute to obtuse apex and base.

*Distr.* Assam, Bengal, Andaman Islands, in *Malaysia*: Malay Peninsula (rare).

*ssp. sumatrana* HOOGL. *ssp. nov.*—*Delimopsis hirsuta* MIQ. *l.c.*—*Delima sarmentosa* f. *hirsutior* MIQ. *l.c.*—*Tetracera hirsuta* BOERL. *l.c.*—*Davilla hirsuta* TEYSM. & BINN. ms.

Young branches hirsute with 1½–2½ mm long hairs together with profusely distributed divergent tufts of ca 3–12 shorter (0.3–0.5 mm long) hairs; branches of the inflorescence similar. *Leaves* with rounded apex and rounded to obtuse base.

*Distr.* *Malaysia*: Sumatra, Malay Peninsula and ?Borneo.

*Ecol.* In forests, up to 1300 m.

*Notes.* The Borneo record is based on sterile material only (*Tetracera setigera* KORTH. ms.).

4. *Tetracera maingayi* HOOGL. *nom. nov.*—*Delima laevis* MAING. ms. ex KING, J. As. Soc. Beng. 58, 2 (1889) 362.—*Tetracera borneensis* (non MIQ.) RIDL. Fl. Mal. Pen. 1 (1922) 6.

Scandent shrub. *Leaves* oblong, ca 7½–15 by 3–6 cm, with acute, somewhat acuminate apex, coriaceous, shining above. *Petiole* 10–20 mm. Inflorescence terminal, rather many-flowered (up to 250), basal part often with 1–3 leaves. *Flower* ca 12–15 mm diam. *Sepals* 5, the outer two 3½ by 3 mm, the inner three 5 by 3½–4½ mm, scabrid outside. *Petals* 3. *Stamens* 2½ mm long; anthercells manifestly separated at the apex. *Carpel* 1, with ca 6 ovules. *Capsule* oblong, 8–12 by 3–4 mm, with a 2–3 mm long beak. *Seeds* unknown.

*Distr.* *Malaysia*: Malay Peninsula (Malacca, Selangor, Penang) and ?Borneo.

*Ecol.* Seems to be rare in lowland forests up to 200 m.

*Vern.* Malay Peninsula: *akar mēmpēlas*, *a. m. bētina*. Borneo: *akar amplas*.

*Notes.* The specific epithet *laevis* is already occupied in *Tetracera*, hence a new name is needed. The single Borneo record is based on a specimen in the Singapore herbarium bearing the inadequate indication 'Borneo, Remow, 1703'.

5. *Tetracera lanuginosa* DIELS, Bot. Jahrb. 57 (1922) 440.

Liana. Branches hirsute with up to 2 mm long hairs, together with groups of very small, stellately grouped hairs (0.1 mm long). *Leaves* elliptic, 5–7 by 3½–4½ cm, slightly scabrid, with rounded apex and base, rather sparsely hirsute with up to 2 mm long, rather rigid hairs. *Petiole* 10–15 mm. Inflorescence terminal on a few-leaved lateral branch, few (2–4)-flowered, ca 3–4 cm long. *Flower* ca 15 mm diam. *Sepals* 5, approximately circular, the outer two ca 4 mm diam., the inner three ca 6 by 7 mm, lanuginose outside together with stellate groups of short hairs, glabrous to very sparsely shortly strigose inside. *Petals* 3, ca 9 by 6 mm. *Stamens* 2½–3 mm long; anthercells strongly separated at the apex. *Carpels* 2–3, with ca 2 mm long, rather thin, ferrugineous hairs. *Fruit* unknown.

*Distr.* *Malaysia*: NE. New Guinea (April River, Sepik District), once collected.

*Ecol.* Primary forest; *fl.* in September.

6. *Tetracera nordtiana* F.v.M. Fragm. 5 (1865) 1; BAIL. Queensl. Fl. 1 (1899) 9; SCHUM. & HOLLR. Fl. Kais. Wilh. (1899) 47; SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 444; BAIL. Compr. Cat. Queensl. Pl. (1909) 18, f. 3.—*Tetracera euryandra* (non VAHL) ROXB. Fl. Ind. ed. CAREY 2 (1832) 646.—*Tetracera wuthiana* F.v.M. Fragm. 10 (1876) 49; BAIL. Queensl. Fl. 1 (1899) 10.—*Tetracera everillii* F.v.M. Descr. Notes Pap. Pl. 7 (1886) 25.—*Tetracera moluccana* MARTELLI in BECC. Malesia 3 (1886) 153.—*Tetracera cowleyana* BAIL. Dept Agric. Brisb. Bot. Bull. 5 (1892) 7; Queensl.

Fl. 1 (1899) 9; Compr. Cat. Queensl. Pl. (1909) 18, f. 3bis.—*Tetracera boerlagei* MERR. Int. Rumph. (1917) 366.—*Tetracera pilophylla* DIELS, Bot. Jahrb. 57 (1922) 440.—*Tetracera volubilis* (non L.) RENDLE, J. Bot. 59 Suppl. (1923) 2.

Shrub or large climber, up to 10 m high, with slightly scabrid branches. Leaves elliptic to lanceolate, *ca* 5–10 by 3–5 cm, with rounded to acute apex and base. Petiole 5–15 mm. Inflorescence terminal, 15–50-flowered, often with 1–3 leaves in the basal part. Flower *ca* 6–10 mm diam. Sepals 4–5, the outer two circular, *ca* 1½–2 mm diam., the inner two or three ovate, *ca* 3–4½ by 2–3½ mm, glabrous or rarely sericeous inside, scabrid outside. Petals 3. Stamens 4–5 mm long; anthercells strongly separated at the apex. Carpels 2–4, usually 3, with rather rigid, 0.5 mm long hairs thinner than

in *T. scandens* (L.) MERR., with *ca* 10 ovules. Capsules ovoid, 5–8 by 3–5 mm with a 1–2 mm long beak, 1-seeded. Seed *ca* 3 by 2½ mm. Aril 5 mm long, lacinate to 2/3–3/4 of its length.

Distr. Queensland (E. coast), in *Malaysia*: SE. Celebes (Kabaena Island), Moluccas (Mangoli of the Sula group, Ceram, Ambon, Aru Islands), New Guinea, and Louisiades.

Notes. A very variable species, of which 6 varieties are distinguished here between some of which intermediate forms occur. Most of these have been described as separate species, but to my opinion the differences do not justify to keep them apart. As they show no geographical exclusion I have provisionally accepted them as varieties instead of subspecies. For further study more material, with notes on the habitat, is highly desirable.

KEY TO THE VARIETIES

1. Sepals slightly sericeous inside . . . . . var. *celebica*
1. Sepals glabrous inside . . . . .
2. Leaves glabrous above . . . . . var. *wuthiana*
2. Leaves more or less hairy above . . . . .
3. Leaves relatively small, *ca* 5–7 by 3–4 mm. Capsules relatively small, *ca* 5 by 3 mm.
4. Indumentum consisting of strigose or strigose-hirsute hairs together with stellate groups of shorter hairs . . . . . var. *nordtiana*
4. Indumentum consisting of strigose-hirsute hairs together with shorter, villous hairs . . . . . var. *louiadiaca*
3. Leaves relatively large, *ca* 8–10 by 4–5 cm. Capsules relatively large, *ca* 8 by 5 mm.
5. Sepals villous outside . . . . . var. *everillii*
5. Sepals strigose outside, with hairs single or in groups of 2–5 . . . . . var. *moluccana*

var. *nordtiana*.—*T. nordtiana* F.V.M. l.c.—*T. pilophylla* DIELS, l.c.—*T. volubilis* (non L.) RENDLE, l.c.

Young branches, branches of the inflorescences, leaves and outer side of the sepals with strigose or strigose-hirsute hairs, together with stellate groups of shorter hairs. Sepals glabrous inside. Capsules rather small, *ca* 5 by 3 mm.

Distr. Queensland, in *Malaysia*: Moluccas (Aru Islands), E. New Guinea.

Ecol. Rain-forest climber.

Notes. The Malaysian specimens show transitions to var. *moluccana* (MARTELLI) HOOGL.

var. *everillii* (F.V.M.) HOOGL. stat. nov.—*T. everillii* F.V.M. l.c.

Young branches, branches of the inflorescences, and leaves hirsute with up to 2 mm long hairs. Sepals villous outside, glabrous inside. Capsules rather large, *ca* 8 by 5 mm.

Distr. *Malaysia*: SE. New Guinea (Fly River, once collected).

var. *wuthiana* (F.V.M.) HOOGL. stat. nov.—*T. wuthiana* F.V.M. l.c.

Young branches, branches of the inflorescences, and nerves on the lower side of the leaves strigose, leaves glabrous above. Sepals sparsely strigose outside, glabrous inside.

Distr. Queensland, in *Malaysia*: an intermediate form to var. *nordtiana* in New Guinea (CARR 12832, Koitaki).

Ecol. In forest *ca* 300 m alt.

var. *moluccana* (MARTELLI) HOOGL. stat. nov.—*T. euryandra* (non VAHL) ROXB. l.c.—*T. moluccana* MARTELLI l.c.—*T. cowleyana* BAIL. l.c.—*T. boerlagei* MERR. l.c.

Young branches and branches of the inflorescences strigose to hirsute with up to 1½ mm long hairs. Leaves sparsely hirsute with rather rigid, up to 1½ mm long solitary hairs. Sepals strigose with up to 0.7 mm long hairs, single or in groups of 2–5, outside, glabrous inside. Capsules rather large, *ca* 8 by 5 mm.

Distr. Queensland, in *Malaysia*: Moluccas, Aru Islands, New Guinea.

Vern. Amboina: *talir hassat*, *hassat* and *hassat cotel*. Probably also: *gumi uccu* (fide RUMPHIUS) in Ternate.

Notes. *Funis urens glabra* RUMPH. Herb. Amb. 5 (1747) 13 may be this species, as has been suggested by MERRILL. The Rumphian description, however, is very defective.

var. *louiadiaca* HOOGL. var. nov.

Young branches and branches of the inflorescences strigose-hirsute with up to 0.8 mm long hairs, together with a rather dense indumentum, closely appressed, of shorter, villous hairs. Leaves hirsute with up to 0.5 mm long hairs, most densely so on the nerves above, densely shortly villous on the intervenium, strigose-hirsute on the nerves beneath. Sepals densely villous outside, glabrous inside. Capsules rather small, *ca* 5 by 3 mm.

Distr. *Malaysia*: Louisiades (Joannet Island, once collected).

var. *celebica* HOOGL. var. nov.

Young branches and branches of the inflorescence rather densely hirsute with up to 0.7 mm long hairs. Leaves hirsute with up to 1 mm long hairs. Sepals slightly sericeous in the central part inside, strigose-hirsute with 0.1–0.3 mm long hairs, partly in groups of 2–5, outside.

Distr. *Malaysia*: SE. Celebes (Kabaena Island).

**7. *Tetracera indica*** (CHRISM. & PANZ.) MERR. Int. Rumph. (1917) 367; BACK. & SLOOT. Theeonkr. (1924) no 174; HEYNE, Nutt. Pl. (1927) 1070; BURK. Dict. (1935) 2143; MERR. J. Arn. Arb. 19 (1938) 354; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 3.—*Eugenia malaccensis* (non L.) BURM. f. Fl. Ind. (1768) 114; cf. STEEN. Bull. Bot. Gard. Btzg 18 (1950) 459.—*Assa* HOUTT. Nat. Hist. 5 (1776) 275, t. 26, f. 1.—*Assa indica* HOUTT. ex CHRISM. & PANZ. Pfl. Syst. 4 (1779) 40, t. 26, f. 1.—*Wahlbomia indica* THUNB. Vet. Akad. Handl. Stockh. (1790) 215, t. 9.—*Assa exotica* GMEL. Syst. (1791) 839.—*Tetracera laevis* VAHL, Symb. Bot. 3 (1794) 71, non al.—*Tetracera assa* DC. Syst. 1 (1818) 402; Hk. f. & Th. Fl. Ind. 1 (1855) 63; MIQ. Fl. Ind. Bat. 1, 2 (1859) 8; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 74; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 31; KING, J. As. Soc. Beng. 58, 2 (1889) 362; BACK. Fl. Batavia 1 (1907) 3; BACK. Schoolfl. Java (1911) 9; KOORD. Exk. Fl. Java 2 (1912) 600; RIDL. Fl. Mal. Pen. 1 (1922) 5.—*Tetracera wahlbomia* DC. Syst. 1 (1818) 403.—*Tetracera malabarica* LAMK, Illustr. 3 (1823) 32, t. 485, f. 1.—*Tetracera dictio-*

*toma* BL. Bijdr. 1 (1825) 4.—*Tetracera gracilis* BL. *ibid.*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 9.—*Tetracera trigyna* ROXB. Fl. Ind. ed. CAREY 2 (1832) 645; HUNTER (ed. by RIDL.) J. Str. Br. R. A. S. 53 (1909) 98.—*Eleiastis laevis* RAFIN. Sylva Tellur. (1838) 165.—Fig. 1.

Shrub to 2 m or liana to 5 m. Leaves elliptic to oblong or obovate, ca 6–10 by 3–5 cm, usually rather thin, slightly glossy above, not scabrid, with acute to obtuse apex. Petiole ca 6–10 mm. Inflorescence terminal on the main branch or on few-leaved axillary branches, few-(usually 4–7)-flowered, up to 8 by 6 cm. Flowers ca 2½–3 cm diam. Sepals 4, 8–10 by 7–9 mm, glabrous. Petals 3–5, usually 4, reddish white. Stamens 6–8 mm long; anthercells reaching each other at the apex. Carpels 3–4, with a few rigid hairs on the back, ovules ca 10–15. Capsules globular, ca 10 mm diam., with a 2–6 mm long beak, 1–7-, usually 2-seeded. Seeds 3½ by 2½ mm. Aril 8–10 mm long, finely fimbriate to nearly its base.

Distr. From Chittagong to S. Burma, S. Siam and S. Indo-China, once collected in China (Fukien), in *Malaysia*: Sumatra, Malay Peninsula, Java, Madura, and Kangean.

Ecol. Small shrub in open places; low liana, climbing over low shrubs, in brushwood and open forest. From sea-level to 600 m. According to BACKER & VAN SLOOTEN, *l.c.*, propagation mainly by suckers.

Vern. Sumatra: *aplas kédjong* (Djambi), *baih siepiek*, *bait siepiek suloh* (Lamp.), *djēlati* (Pal.), *mēmplas gadja* (Sum. E. Coast), *sipik suluh* (Lamp.), *wajit sipit* (Mengg.). Malay Peninsula: *akar pulas duyio*, *ampalas* (*ampēlas*, *ēmpēlas*, *hēmpēlas*, *mēmpēlas*), *ampalas lichin*, *a. mihsak*, *a. minyak*, *a. payah*, *kalintat niamok*, *ma ampalasu akar*. Banka: *akar tēmpēlas*. Java: *akar mēmpēlas* (*tēmpēlas*), *asahan*, *ēmpē as* (*mēmpēlas*) *akar*, *kaju as(s)ahan* (Mal.); (*areuj*) *ki as(s)ahan* (Sund.); *bo* (Jav.). Kangean: *buko-buko*.

Uses. For cordage; leaves (BURKILL, *l.c.*) as sandpaper? Medical use unimportant, cf. BURKILL, *l.c.*



Fig. 1. *Tetracera indica* (CHRISM. & PANZ.) MERR. with buds, flowers, and fruits (right lower corner). Palembang (DE VOOGD).

**8. *Tetracera akara*** (BURM. f.) MERR. Philip. J. Sc. 19 (1921) 366.—*Akara-Patsjōti* RHEEDE, Hort. Mal. 5 (1685) 15, t. 8.—*Calophyllum akara* BURM. f. Fl. Ind. (1768) 121.—*Tetracera laevis* (non VAHL) DC. Syst. 1 (1818) 401; Hk. f. & Th. Fl. Ind. 1 (1855) 62; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 74; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 31; BACK. Schoolfl. Java (1911) 9; Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 2.—*Tetracera sericea* BL. Bijdr. 1 (1825) 3; MIQ. Fl. Ind. Bat. 1, 2 (1859) 9.—*Tetracera assa* (non DC.) HASSK. Pl. Jav. Rar. (1848) 177.—*Tetracera axillaris* MARTELLI in BECC. Malesia 3 (1886) 151.—*Tetracera assa* var. RIDL. J. Str. Br. R. A. S. 33 (1900) 37.—*Tetracera sylvestris* RIDL. J. Str. Br. R. A. S. 54 (1910) 8; Fl. Mal. Pen. 1 (1922) 5.

High climbing or creeping liana, up to 25 m. Leaves oblong to lanceolate, ca 8–13 by 3½–6 cm, rather coriaceous, bright glossy green above, not scabrid, with acuminate apex. Petiole 5–7 mm.

Inflorescence terminal or axillary, few-(usually 5–8)-flowered, up to 8 by 6 cm. *Flowers* ca 2½–3 cm diam. Sepals 4, 8–10 by 6–8 mm, glabrous outside, densely sericeous on the centre inside. Petals 3–4, white or greenish white. Stamens 7–8 mm long; anthercells reaching each other at the apex. Carpels 3–4, with ca 10 ovules. *Capsules* globular, ca 10 mm diam., with a 1–3 mm long beak, 1–2-seeded. Seeds 3 by 2 mm. Aril 6 mm long, fimbriate for 1½–¾ of its length.

Distr. S. India, Ceylon, in *Malaysia*: Sumatra, Malay Peninsula, W. Java, Borneo, and Celebes.

Ecol. In lowland forests, up to 750 m alt.

Vern. Sumatra: *daun amplas* (Pal.). Malay Peninsula: *akar*, *akar rusa-rusa*, *mumplas rimba*. Java: *aroy pēngasaman* (Sund.).

Notes. *T. axillaris* MARTELLI represents a small-leaved form, to my opinion of no taxonomical value. The acuminate, glossy leaves are typical for the species.

**9. *Tetracera loureiri*** (FIN. & GAGNEP.) CRAIB, Kew Bull. (1922) 165; Fl. Siam. En. 1 (1925) 20.—*Tetracera assa var. loureiri* FIN. & GAGNEP. Bull. Soc. Bot. Fr. Mém. 4 (1906) 3.—*Tetracera sarmentosa var. loureiri* FIN. & GAGNEP. Fl. Gén. I.C. 1 (1907) 16.—*Tetracera fragrans* RIDL. J. Str. Br. R. A. S. 59 (1911) 62; Fl. Mal. Pen. 1 (1922) 6, non WILDEM. & DUR. (1899).

Low climber. *Leaves* elliptic to oblong, ca 5–11 by 2½–6 cm, rather coriaceous, not or slightly scabrid, with rounded or obtuse apex. Petiole ca 7–10 mm. Inflorescence terminal, many-(usually 40–80)-flowered, often with 1–2(–4) leaves in the basal part, 10–20 by 5–10 cm. *Flower* ca 10 mm diam. Sepals 5, the outer two ca 4½ by 3½ mm, the inner three 6½ by 4½ mm, slightly scabrid outside. Petals 3. Stamens 4–5 mm long; anthercells manifestly separated to nearly reaching each other at the apex. Carpels 2–3, with 8–16 ovules. *Capsules* ovoid, 7½ by 5½ mm with a 2 mm long beak, 1–2-seeded. Seeds 2–3 mm diam. Aril unequal-sided, 2–6 mm long, lacinate to 1½–¾ of its length.

Distr. Siam and S. Indo-China, in *Malaysia*: only in the N. of the Malay Peninsula.

Ecol. In thickets and hedges, from sea-level up to 400 m.

Vern. In the Malay Peninsula noted only: *mēmpēlas*.

**10. *Tetracera korthalsii*** MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 75; MERR. En. Born. (1921) 381.—*Tetracera subrotunda* ELM. Leaf. Philip. Bot. 5 (1913) 1771.—*Tetracera elmeri* MERR. Univ. Calif. Publ. Bot. 15 (1929) 194.

Large climber or creeper with scabrid branches. *Leaves* broadly elliptic to elliptic-oblong or obovate, smooth to slightly scabrid on both sides. Inflorescence 40–200 or more-flowered, terminal, basal part often with 1–2 leaves, 10–30(–100) by 6–20 cm, with more or less scabrid branches. *Flower* ca 10 mm diam. Sepals 5(–6), the outer two 4 by 3, the inner three (or four) 5 by 4 mm, scabrid outside. Petals 3. Stamens 3½–4 mm long; anthercells strongly separated at the apex. Carpels 3,

with ca 9 ovules. *Capsules* ovoid, ca 7 by 4 mm with a 1–2 mm long beak, 1-seeded. Seeds 4½ by 3½ mm. Aril unequal-sided, 2½–5 mm long, lacinate to 1½–½ of its length.

Distr. *Malaysia*: Borneo, Palawan, Celebes, W. Moluccas (Taliabu of the Sula group).

Notes. The species can be divided into 2 varieties on account of the leaf-shape; there are no differences in floral characters and intermediate forms are unknown.

*var. korthalsii.*

*Leaves* elliptic-oblong, ca 6½–17 by 4–8 cm; apex acute or slightly acuminate, base acute. Petiole ca 8–20 mm.

Distr. *Malaysia*: Borneo, Celebes, W. Moluccas (Taliabu).

Ecol. Climber in forests, up to 700 m alt.

Vern. Borneo: *ēmpēlas* (Mal.), *pampad* (Dusun).

Uses. Used for polishing wood.

*var. subrotunda* (ELM.) HOOGL. *stat. nov.*—*Tetracera subrotunda* ELM. *l.c.*—*Tetracera elmeri* MERR. *l.c.*

*Leaves* broadly elliptic, ca 8½–22 by 5½–13 cm; apex and base rounded. Petiole 12–30 mm.

Distr. *Malaysia*: Br. N. Borneo (Tawao), Philippines (Palawan).

Ecol. A large climber in primary forest at low alt.

Notes. *Tetracera elmeri* MERR. represents a hirsute form.

**11. *Tetracera macrophylla*** WALL. *ex* HK. *f.* & TH. Fl. Ind. 1 (1855) 63; MIQ. Fl. Ind. Bat. 1, 2 (1859) 8; HK. *f.* & TH. Fl. Br. Ind. 1 (1872) 32; KING, J. As. Soc. Beng. 58, 2 (1889) 363; RIDL. Fl. Mal. Pen. 1 (1922) 4; BURK. Dict. (1935) 2143.—*Tetracera macrocarpa* WALL. Cat. (1828) no 6628, *nomen.*—*Tetracera scaberrima* MIQ. Fl. Ind. Bat. 1, 2 (1859) 8; Ann. Mus. Bot. Lugd. Bat. 4 (1868) 75; MERR. En. Born. (1921) 382.—*Tetracera teysmannii* MARTELLI in BECC. Malesia 3 (1886) 150.—*Tetracera radula* MARTELLI in BECC. Malesia 3 (1886) 153; MERR. En. Born. (1921) 382, *non* MARTIUS (1863).—*Tetracera grandis* KING, J. As. Soc. Beng. 58, 2 (1889) 363; Ann. Roy. Bot. Gard. Calc. 5 (1896) 115, t. 129; RIDL. Fl. Mal. Pen. 1 (1922) 4.—*Tetracera havilandii* RIDL. Kew Bull. (1912) 381.—*Tetracera scabricaulis* RIDL. Kew Bull. (1912) 381.

Liana up to 10 m or ?tree; younger branches usually more or less scabrid. *Leaves* elliptic to oblong, ca 8–15 by 5–10 cm, little to very scabrid, with rounded to obtuse apex and base. Petiole ca 15–30 mm long, 2–4 mm broad, up to 8 mm broad in the leaves at the base of the inflorescences. Inflorescence terminal, 25–200-flowered, often with 1–4 leaves in the basal part, 10–40 by 4–15 cm; branches scabrid with stellate groups of hairs. *Flower* ca 2–2½ cm diam. Sepals 5–6, the outer two 8–9 by 7–8 mm, the inner 3–4 11–12 by 8–9 mm, scabrid outside. Petals 3, rather thick, apex not emarginate. Stamens 5–7 mm long; anthercells mani-

festly separated at the apex, connective strongly emarginate between them. Carpels 3–4, with a few rigid hairs on the back, with *ca* 14 ovules. *Capsules* ovoid, 8–10 by 6–8 mm with a 2–3 mm long beak, 1–2-seeded. Seeds  $6\frac{1}{2}$  by  $4\frac{1}{2}$  mm; aril unequal-sided, 5–9 mm long, slightly laciniate over *ca*  $\frac{1}{8}$  of its length.

Distr. *Malaysia*: Sumatra, Malay Peninsula, Banka, Borneo.

Ecol. Climber in dry as well as in swampy forests, up to 300 m alt. Seems to be rarely in flower.

Vern. Sumatra: *akar ampaleh riembu* (Sum. W. Coast). Malay Peninsula: *ampalas gajah* (= elephant or big a.), *a. rimau* (= tiger a.), *a. rimbah*, *a. lidah kucing* (= cat's tongue a.). Borneo: *akar tembara* (W. Kutei), *ampalas* (Saraw.).

Uses. Medical use unimportant, cf. BURKILL, *l.c.*

Notes. The species is very variable as to leaf-size and degree of scabridness; it is most easily recognized by its calyx (outer two sepals glabrous, inner sepals densely sericeous inside) and rather large flowers.

12. *Tetracera arborescens* JACK, Mal. Misc. 1, 5 (1820) 45; MIQ. Fl. Ind. Bat. 1, 2 (1859) 9; GAGE & BURK. J. Str. Br. R. A. S. 73 (1916) 242.—*Tetracera euryandra* (non VAHL) HK. f. & Th. Fl. Ind. 1 (1855) 63; MIQ. Fl. Ind. Bat. 1, 2 (1859) 8; Ann. Mus. Bot. Lugd. Bat. 4 (1868) 75; HK. f. & Th. Fl. Br. Ind. 1 (1872) 32; KING, J. As. Soc. Beng. 58, 2 (1889) 362; BACK. Schoolfl. Java (1911) 9.—*Tetracera laevigata* MIQ. Fl. Ind. Bat. 1, 2 (1859) 8; Ann. Mus. Bot. Lugd. Bat. 4 (1868) 74.—*Tetracera subcordata* BOERL. Cat. Hort. Bog. (1899) 3.—*Tetracera lucida* WALL. Cat. (1828) no 6631, nomen; RIDL. Fl. Mal. Pen. 1 (1922) 5.—*Tetracera lucida* var. *lanuginosa* RIDL. *ibid.*

Strong woody climber, shrub or ?small tree. Younger branches villose to densely villose-floccose. *Leaves* obovate to elliptic-oblong, ca 6–10 by 3–5 cm, coriaceous, not scabrid, the upper ones under the inflorescence 3–4 by 2–3 cm, often villose-floccose when young. Petiole 3–5 mm. Inflorescence terminal, (6–)10–50-flowered, up to 15 by 6 cm. *Flower* ca 15 mm diam. Sepals 5–6, ca 5 by 3 mm, slightly scabrid outside. Petals 3, white. Stamens 4–5 mm long; anthercells slightly to manifestly separated at the apex. Carpels 3, with *ca* 10–12 ovules. *Capsules* ovoid, 7 by 4 mm with a 2–3 mm long beak, 1-seeded. Seeds  $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm. Aril 3–5 mm long, laciniate to half its length.

Distr. *Malaysia*: Sumatra (Tapanuli, East Coast), Malay Peninsula, Banka, Billiton, Borneo, and ?W. Java (Papandajan, KORTHALS).

Ecol. Swampy forests, riverside scrubs, only at low altitudes.

Vern. Sumatra: *andor ruhas igung* (Tapan.), *mohi-mohi* (Sibolga). Banka: *akar tēmpēlas*. Billiton: *akar mēmplas*.

Notes. JACK's description is insufficient. From study of a specimen of JACK, present in the Leyden herbarium, it is clear that the present species was meant.

13. *Tetracera fagifolia* BL. Bijdr. 1 (1825) 4; MIQ. Fl. Ind. Bat. 1, 2 (1859) 9; Ann. Mus. Bot. Lugd.

Bat. 4 (1868) 75; RIDL. J. Str. Br. R. A. S. 54 (1909) 10; Fl. Mal. Pen. 1 (1922) 6, non WILLD. ex SCHLECHT. (1833).—*Tetracera rigida* BL. Bijdr. 1 (1825) 4; MIQ. Fl. Ind. Bat. 1, 2 (1859) 9; BACK. Schoolfl. Java (1911) 9; Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 2.—*Tetracera blumei* WALP. Rep. 1 (1842) 67.—*Tetracera sumatrana* MIQ. Fl. Ind. Bat. Suppl. 1 (1861) 618, 619.—*Tetracera fagifolia* f. *subintegerrima* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 75.—*Tetracera borneensis* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 76; MERR. En. Born. (1921) 381.—*Tetracera obovata* BOERL. Cat. Hort. Bog. (1899) 3.—*Tetracera philippinensis* MERR. Philip. J. Sc. Bot. 9 (1914) 375; En. Philip. 3 (1923) 58.—*Tetracera obliquinervis* ELM. Leaf. Philip. Bot. 7 (1915) 2621.—Fig. 2.

Liana, up to 14 m high, branches slightly scabrid. *Leaves* elliptic to lanceolate, more or less coriaceous, usually shining. Petiole *ca* 7–20 mm. Inflorescence terminal, *ca* 40–250-flowered, often with 1(–3) leaves in the basal part, *ca* 15–40 by 8–25 cm; branches scabrid, with small tufts of 0.2–0.4 mm long hairs on the extreme branches only. *Flower* ca 8–12 mm diam. Sepals 5(–6), the outer two 4 by 4 mm, the inner 3(–4)  $5\frac{1}{2}$ –7 by  $4\frac{1}{2}$ – $5\frac{1}{2}$  mm, scabrid outside. Petals 3. Stamens  $4\frac{1}{2}$ –6 mm long; anthercells manifestly separated at the apex, connective somewhat emarginate between them. Carpels 3, with *ca* 10 ovules. *Capsules* ovoid, 5–8 by 4–6 mm, with a 1–3 mm long beak, 1(–2)-seeded. Seeds 5 by 3 mm. Aril *ca* 7 mm long, unequal-sided, laciniate to  $\frac{1}{4}$ – $\frac{1}{2}$  its length.

Distr. *Malaysia*: Sumatra, Malay Peninsula, Banka, W. Java, Borneo, Philippines.

Notes. The 2 varieties, distinguished here, differ only in their vegetative parts. There is a relatively small number of intermediate forms.

The first to consider *T. fagifolia* BL. and *T. rigida* BL. as conspecific was MIQUEL (1868) *l.c.*, who used the first name.

#### var. *fagifolia*.

Leaves *ca* 12–16-nerved, 1.4–2.25 times as long as broad, *ca* 7–20 by 5–10 cm; the lateral nerves curving upward, ending in the margin.

Distr. *Malaysia*: Sumatra (incl. Simalur and Mentawai), Malay Peninsula (Johore), W. Java, Borneo, Philippines.

Ecol. Climber in primary forest, in scrub or in bamboo forest, 100–750 m alt.

Vern. Sumatra: *alor ampaleh* (Simalur), *ampalu riembu* (Lamp.), *sapbet* (Siberut). Java: *aroy (ki) assahan, kiassahan, ki saun* (Sund.). Philippines: *balau-balau* (Mbo).

var. *borneensis* (MIQ.) HOOGL. *stat. nov.*—*Tetracera borneensis* MIQ. *l.c.*

Leaves *ca* 8–10-nerved, 1.4–3.5 times as long as broad, *ca* 6–13 by 2.7–5.5 cm; lateral nerves not quite reaching the margin.

Distr. *Malaysia*: Sumatra (Muara Mengkulen, once collected), Banka, Borneo, SE. Celebes (Kendari).

Ecol. Primary forest; on Mt Kinabalu up to 1300 m.

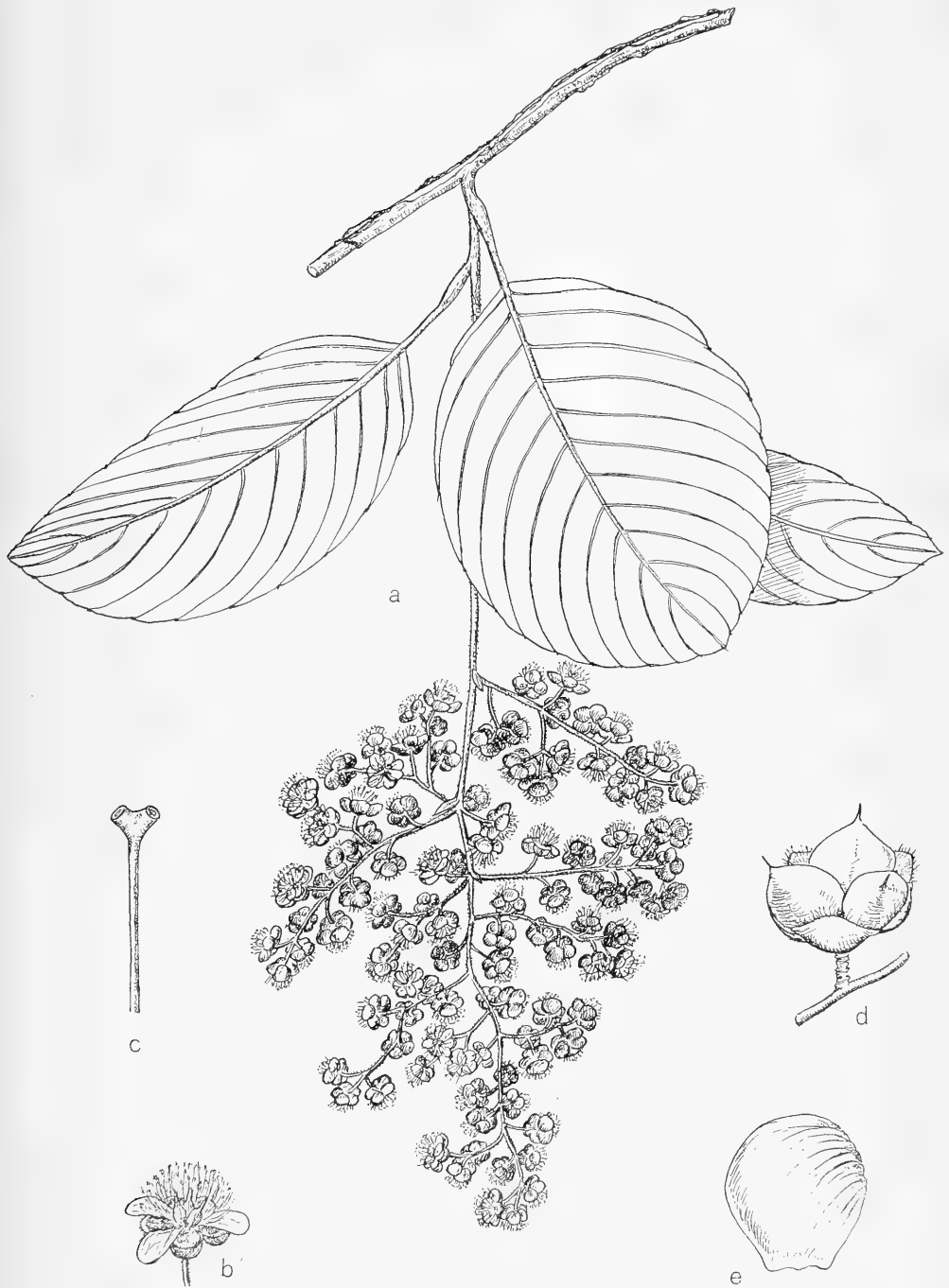


Fig. 2. *Tetracera fagifolia* BL. *a.* Flowering branch,  $\times \frac{2}{3}$ , *b.* flower,  $\times 2$ , *c.* stamen,  $\times 7$ , *d.* fruits,  $\times 2$ , *e.* seed enveloped by aril,  $\times 4$ .

## 2. HIBBERTIA

ANDR. Bot. Rep. (1800) t. 126; B. & H. Gen. Pl. 1 (1862) 14; BTH. Fl. Austr. 1 (1863) 17; BAIL. Queensl. Fl. 1 (1899) 11.

Small ericoid or erect shrubs, rarely trees or lianas, mostly much branched. *Leaves* spirally arranged, rarely opposite (Madagascar), simple, often with reflexed margins. Inflorescence dichasial, usually reduced to a few-flowered pseudo-raceme, spike or to solitary flowers. Bracts and bracteoles often present. *Flowers* sessile or shortly pedicellate. Sepals 5. Petals 5(-3). Stamens  $\infty$ -3, often partly staminodial, either surrounding the carpels regularly or reduced on one side, free or slightly connate at the basis, introrse, opening with longitudinal slits, rarely with apical pores. Carpels  $\infty$ -1, with 15-1 ovules, free. Style filiform, usually curved or recurved. *Follicles* usually one-seeded. Seed arillate.

Distr. A large genus with *ca* 100 species in Australia and Tasmania, 20 in New Caledonia, one in the Fiji Islands, two in extreme Eastern Malaysia, and one in Madagascar (fig. 3).

## KEY TO THE SPECIES

1. Stamens and staminodes all placed on one side of the carpels. Carpels 2. Shrubs . . . 1. *H. banksii*  
1. Stamens placed regularly round the carpels, without staminodes. Carpels 5. Scandent . . . 2. *H. scandens*

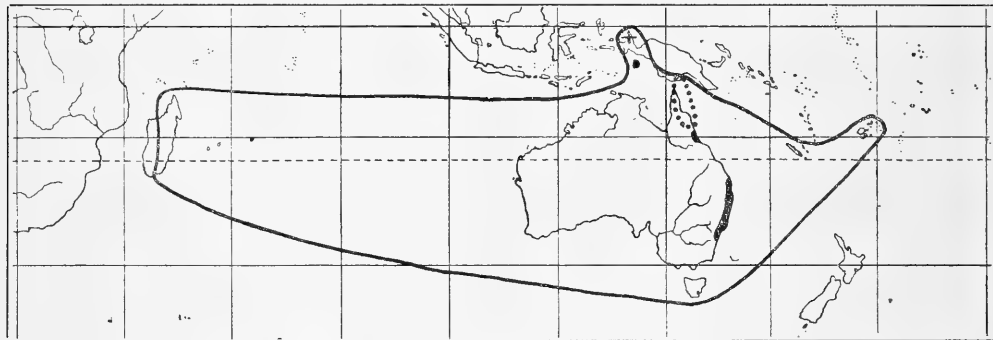


Fig. 3. Distribution of the genus *Hibbertia*. Separately indicated are the areas of *H. banksii* (R.BR. ex DC.) BTH. (---), *H. scandens* (WILLD.) DRYAND. (3 black spots), and *H. scandens* var. *novoguineensis* (GIBBS) HOOG. (+).

1. *Hibbertia banksii* (R.BR. ex DC.) BTH. Fl. Austr. 1 (1863) 20; BAIL. Queensl. Fl. 1 (1899) 12; BANKS & SOLANDER, Illustr. Bot. Cook's Voy. 1 (1900) 5, t. 2; A. C. SMITH, J. Arn. Arb. 22 (1941) 497.—*Hemistemma banksii* R.BR. ex DC. Syst. 1 (1818) 414.

Shrub 1-2 m. *Leaves* oblong-lanceolate with a few obtuse teeth, stiff with recurved margins, glossy green above, pubescent below with a rusty brown tomentum on the nerves and a yellowish tomentum on the intervenium, 5-15 by 0.7-3 cm. Raceme axillary, 5-12-flowered, 4-6 cm long. *Flowers* almost sessile. Sepals oblong, acute, densely hairy outside, 8 by 4 mm. Petals yellow, obovate with emarginate apex, 14 by 7 mm. Stamens *ca* 25, 3½ mm long; staminodes *ca* 12, on the outside of the stamens, 2.7 mm long. Carpels densely hairy, with 3 ovules. *Follicles* one-seeded, thin-walled. Seed with membranaceous aril.

Distr. N. Queensland, E. coast, rare, in *Malaysia*: S. New Guinea, Wassi Kussa River region, once collected (fig. 3).

Ecol. The only New Guinea specimen was found in *Agonis* scrub.

2. *Hibbertia scandens* (WILLD.) DRYAND. in KON. & SIMS, Ann. Bot. 2 (1807) 525.—*Dillenia scandens* WILLD. Sp. Pl. 2 (1799) 1351.—*Hibbertia volubilis* ANDR. Bot. Rep. (1800) t. 126; BTH. Fl. Austr. 1 (1863) 37; BAIL. Queensl. Fl. 1 (1899) 16.—*Dillenia volubilis* VENT. Choix (1803) 11.—*Hibbertia novoguineensis* GIBBS, Phytogr. & Fl. Arfak Mts (1917) 148; KANEH. & HATUS. Bot. Mag. Tokyo 57 (1943) 63.—Fig. 4.

Low scandent shrub. *Leaves* lanceolate, acute to acuminate, slightly hairy above, rather densely to densely hairy beneath, 3-12 by 0.4-2½ cm. *Flowers* solitary on short few-leaved side-stalks, *ca* 4 cm diam. Sepals ovate, acute, densely hairy outside, woody, 15-18 by 8-9 mm. Petals yellow, obovate with slightly emarginate apex, *ca* 2 by 1.4 cm. Stamens  $\infty$ , 7-9 mm long. Carpels glabrous, with 6 ovules. *Follicles* 1-6-seeded. Seed with membranaceous aril.

Distr. Australia along the E. coast except the extreme North, S to ca  $35^{\circ}$ , in *Malaysia*: Aru Islands (Trangan: BUWALDA 5510) and NW. New Guinea (Arfak Mts) (fig. 3).



Fig. 4. *Hibbertia scandens* (WILLD.) DRYAND. var. *novoguineensis* (GIBBS) HOOGL., nat. size.

Ecol. In Trangan at low alt., on the Arfak Mts between 2000 and 3000 m in low spinneys on burnt open summit.

Notes. In *Malaysia* two varieties can be distinguished on the leaf-shape: var. *scandens* with leaves rather densely hairy beneath, 6–12 by 1.2–2½ cm (Trangan Island), and var. *novoguineensis* (GIBBS) HOOGL. stat. nov. (*H. novoguineensis* GIBBS) with leaves densely hairy beneath, smaller and narrower, 3–8½ by 0.4–1 cm (Arfak Mts). The stamens in the type specimen of *H. novoguineensis* are 7 mm long, in the collection of KANEHIRA & HATUSIMA 9 mm, in var. *scandens* they are 9 mm. In var. *novoguineensis* the anthercells are relatively longer than in var. *scandens*. These differences, however, do not justify to my idea the distinction of the two forms as separate species.

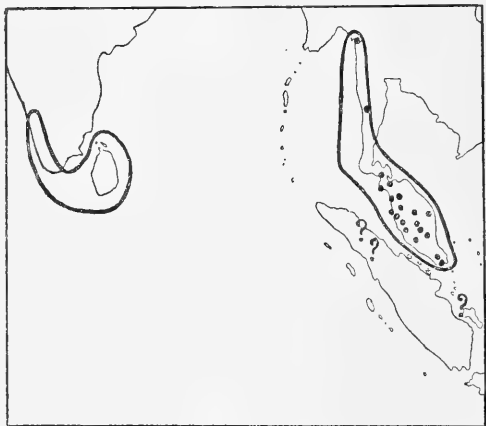


Fig. 5. Geographical distribution of the genus *Acrotrema*; the dots represent the localities of *A. costatum* JACK, the question marks doubtful records of this species.

### 3. ACRO TREMA

JACK, Mal. Misc. 1, 5 (1820) 36; HK. f. & TH. Fl. Ind. 1 (1855) 64; B. & H. Gen. Pl. 1 (1862) 13; HK. f. & TH. Fl. Br. Ind. 1 (1872) 32; TRIM. Handb. Fl. Ceyl. 1 (1893) 6.

Perennial herbs with a horizontal, woody rhizome. *Leaves* all radical or on a short stem, simple, pinnatisect or pinnate, the petiole with sheathing, membranaceous, caducous wings. Inflorescence a terminal raceme, sometimes reduced to a single flower, with membranaceous bracts. *Flowers* 5-merous. Stamens 15–∞, usually in 3 bundles alternating with the carpels. Carpels usually 3, slightly coherent in the centre, with linear, recurved styles, with 2–6 or 10–20 ovules. *Follicles* irregularly dehiscent, with 1–15 seeds. Seeds with a white membranaceous aril.

Distr. Ca 10 spp., 1 in the Deccan Peninsula and 8 in Ceylon, 1 in Lower Burma, Peninsular Siam and the Malay Peninsula (fig. 5).

1. *Acrotrema costatum* JACK, l.c.; KING, J. As. Soc. Beng. 57, 2 (1890) 361; HK. f. & TH., l.c. (1855) 65; KURZ, Nat. Tijds. Ned. Ind. 27 (1864) 175; HK. f. & TH., l.c. (1872) 32; GAGE & BURK.

J. As. Soc. Str. Br. 73 (1916) 242; MERR. En. Born. (1921) 382; RIDL. Fl. Mal. Pen. 1 (1922) 7; BURK. Dict. (1935) 41; HENDERS. Mal. Wild Fl. 1 (1949) 20, f. 9.—Fig. 6.



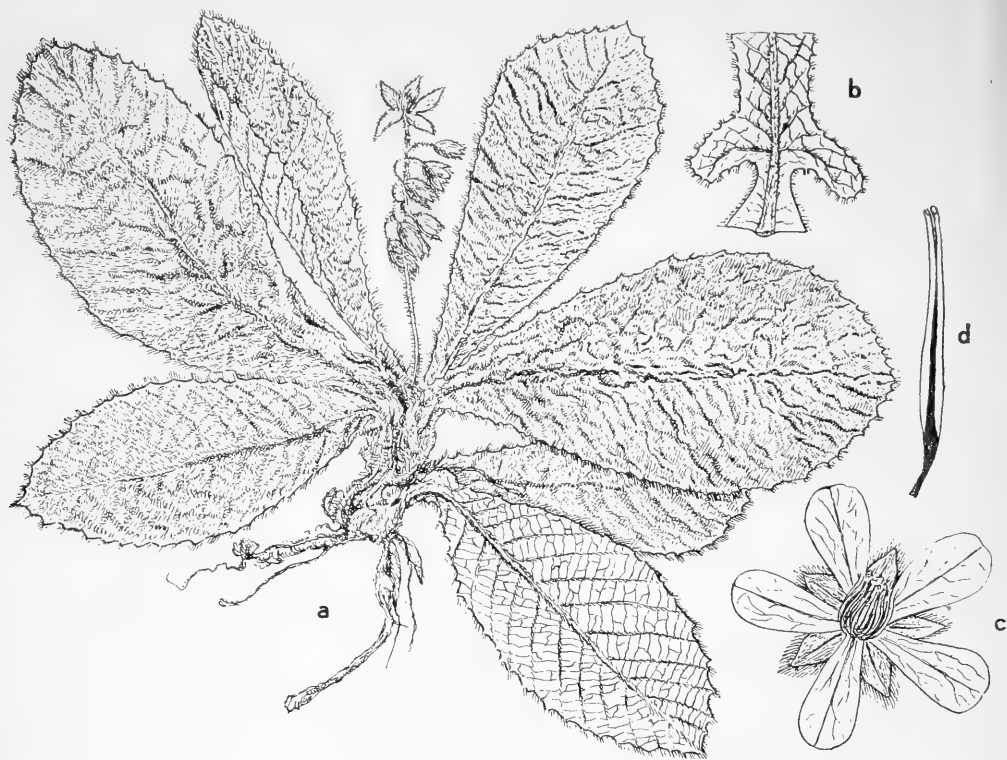


Fig. 6. *Acrotrema costatum* JACK. a. Habit,  $\times 2/3$ , b. leafbase,  $\times 2/3$ , c. flower,  $\times 4/3$ , d. stamen,  $\times 7$ .

Stem from very short up to 25 cm long. *Leaves* obovate, dentate, base auriculate, hairy, deep green, often with a whitish line along the midrib, 7–25 by 3–10 cm; petiole 1–2(–6) cm. Raceme 9–13 cm, erect, ca 10–12-flowered; bracts ca 6 by 2 mm. *Flowers* yellow, diam. 3 cm, opening singly; pedicel 5–15 mm long. Carpels 3, with 2–6 ovules. *Follicles* enclosed by the sepals. Seeds finely echinate.

*Distr.* Lower Burma, Peninsular Siam, in *Malaysia*: Malay Peninsula, N. Sumatra?, Banka?

*Ecol.* In dense, wet forests or on moist shady rocks; up to 1000 m alt.

*Vern.* Once noted: *punai tanah* (Pahang).

*Notes.* One Sumatra record is based on a specimen, collected by BATTEN POOLL, labeled only: Sumatra, 1939; the other is based on a note by JACK (cf. GAGE & BURK. *l.c.*). Of the Banka record (cf. KURZ, *l.c.*) I have seen no material. The Borneo record of MERRILL, *l.c.*, was based on a specimen of *Neurocalyx* sp. (Rubiaceae).

#### 4. DIDESMANDRA

STAPP in HOOK. Icon. t. 2646 (1900).

Woody plants with scabrid, hairy branches. *Leaves* with amplexicaul sheath and short petiole. *Flowers* regular in calyx and corolla, zygomorphic in androecium and gynoecium, placed one-sided on simple or bifurcate branches of a 4–6-branched panicle with reduced central axis, almost sessile. Sepals and petals 5. Stamens in 2 bundles on the adaxial side of the carpels, each bundle consisting of 1 stamen and 4 staminodes with connate filaments, the stamen uncinately curved, exceeding the staminodes, with longitudinally dehiscent linear anthercells, the connective forming a deltoid membrane above the cells, the staminodes only slightly curved. Carpels 2, with a long filiform style; ovule 1, inserted at the base. *Fruit* a nut. Seed with a thin membranaceous aril.

*Distr.* Monotypic, known only from Borneo.



Fig. 7. *Didesmandra aspera* STAFF. a. Habit,  $\times \frac{1}{2}$ , b. flower,  $\times \frac{1}{2}$  (after STAFF), c. stamen and 4 staminodes,  $\times 3$ , d. tip of staminode,  $\times 10$ , e. ditto of stamen,  $\times 10$ , f. ovary,  $\times 3$ , g. seed (black) with unilateral aril,  $\times 3$ .

Notes. Most closely allied to *Schumacheria* VAHL from Ceylon, which has many stamens in one bundle, without staminodes.

1. *Didesmandra aspera* STAPF, l.c.; MERR. En. Born. (1921) 382.—Fig. 7.

Plant ca 2½ m high. *Leaves* scabrid, ovate, apex acute, base rounded, margin slightly toothed, 15–30 by 7–13 cm, 12–16-nerved; nerves prominent and hairy beneath; petiole channelled, 1½–3 cm. Inflorescence 15–20 cm long. Flowers ca 5 cm

diam. Sepals elliptic-oblong, the 2 outer ones smaller. Petals obovate, 25 by 13 mm, yellow. Filament 2 mm long, 1 mm thick, anther 17 mm long, sterile anthers 8–10 mm. Carpels and fruit glabrous; style 15–20 mm.

Distr. *Malaysia*: Borneo (Sarawak), twice collected.

## 5. DILLENIA

LINNÉ, Sp. Pl. 1 (1753) 535; Gen. Pl. ed. 5 (1754) 239.—*Wormia* ROTTB. Nye Samml. Danske Vid. Selsk. Skrift. 2 (1783) 532.—*Lenidia* THOU. Gen. Nov. Madag. (1806) 17.—*Colbertia* SALISB. Parad. Lond. (1807) sub t. 73.—*Capellia* BL. Bijdr. (1825) 5.—*Reifferscheidia* PRESL, Rel. Haenk. 2 (1836) 74.—*Capellenia* BL. ex HASSK. Cat. Pl. Hort. Bog. (1844) 187.

Trees or shrubs, often with reddish bark peeling off in thin papery scales. *Leaves* spirally arranged, simple. Petiole in a number of species with usually wholly caducous, rarely partly or wholly persistent, broad wings, amplexicaul in the young leaf and then enclosing and protecting the terminal bud. *Inflorescence* a composed or simple raceme, in a number of species reduced to solitary flowers, usually terminal on consequently sympodial branches, in one species axillary; one species with terminal and cauline inflorescences, some other (mainly extra-Malaysian) ramiflorous with fascicled flowers. Bracts small, caducous, or obsolete. Bracteoles well developed in some *spp.*, in others obsolete. *Flowers* actinomorphic. Sepals (4–)5(–6), in a few species more, concave. Petals 5, in some species absent, in one species 4–6, usually obovate with rounded apex, yellow or white, rarely reddish. Stamens ∞, all of approximately the same length or of different lengths arranged in 2 or more, not always sharply separated groups; occasionally part of the outermost stamens staminodial, in some species a wholly staminodial outer group, in one species a wholly staminodial inner group. Anthercells parallel, opening usually with a terminal pore, less often with longitudinal slits. Carpels 4–20, coherent along the cuneate central part of the receptacle, with filamentous or linear, more or less spreading styles; stigma in most *spp.* indistinct, only in 2 species (*D. serrata* THUNB. and *D. celebica* HOOGL.) distinct, knoblike. Ovules 6 to ca 60. *Fruit* either dehiscent, the rather fleshy carpels spreading like a star, or indehiscent, enclosed by the more or less enlarged and thickened sepals. Seeds arillate or exarillate, glabrous or rarely finely echinate.

Distr. Ca 60 *spp.*, from Madagascar and the Seychelles to the Fiji Islands, in the North to the S. slopes of the Himalayas, Yunnan, Kwangsi and Kwangtung, in Australia only one species on the E. coast of Queensland; not in New Caledonia. The most widespread species are *D. indica* L. (from India to Borneo and Java) and *D. pentagyna* ROXB. (cf. fig. 12). There are a number of local endemics, particularly in the Philippines, New Guinea, and the Pacific Islands.

Ecol. Most species occur in evergreen forests on dry to very wet soil. Some deciduous species are found in monsoon forests or savannahs, one evergreen species in savannahs of New Guinea and N. Australia. As to altitudinal distribution the species generally occur below 1000 m, but some are occasionally found above this altitude, up to 2000 m; one species (*D. montana* DIELS) has been collected only above 1000 m.

Stilt-roots occur constantly only in a few species, viz *D. borneensis* HOOGL., *D. eximia* MIQ., and *D. reticulata* KING; in a few others they may be occasionally developed, e.g. in *D. papuana* MARTELLI and *D. albiflos* (RIDL.) HOOGL.

The leaves of saplings and young plants are often considerably larger than those of the full-grown plants. In most cases these leaves are relatively narrower, without showing a distinct dimorphism. In



J.T.'51

Fig. 8. *Dillenia papuana* MARTELLI. a. Fruiting branch,  $\times 2/5$ , b. winged petiole of young leaf,  $\times 2/5$ , c. inflorescence,  $\times 2/5$ , d. longitudinal section of flower during full anthesis,  $\times 4/5$ , e. stamens,  $\times 2$ , f. apex of anther,  $\times 4$ , g. seed with aril,  $\times 2$ .

*D. ferruginea* (BAILL.) GILG from the Seychelle Islands, however, a distinct leaf-dimorphism is found between these leaves. In a less degree this is found in Malaysia in *D. pentagyna* ROXB. and probably in *D. pteropoda* (Miq.) HOGL.

In some species the petals drop without having opened in anthesis. In Malaysia this is found only in *D. papuana* MARTELLI and some other New Guinean species.

The dispersal of fruits and seeds is effected mainly by animals. The indehiscent fruits would be eaten mainly by mammals, the arillate seeds of the species with dehiscent fruits by birds. Transport by water is a means of dispersal in *D. indica* L.

Uses. Though sometimes used for light constructions, the wood is generally of low value because of the short durability. *D. pentagyna* ROXB. is used for making a charcoal of good quality.

The indehiscent fruits of some species are eaten, in particular in curries and jellies; they have an acid taste. Mixed with syrup they make a cough cure, and they are sometimes used for washing the hair.

Because of the beautiful flowers and foliage a number of species are suitable as ornamental trees or shrubs, e.g. *D. indica* L., *D. philippinensis* ROLFE, and *D. suffruticosa* (GRIFF.) MARTELLI.

Wood anat. MOLL & JANSSONIUS, Mikr. Holzes 1 (1906) 67: ground tissue originally described as libriform fibers which error was later corrected into fibertracheids, see also REINDERS, Handl. Pflanzen-anatomie 4 ed. Wageningen (1915) 142–147; PEARSON & BROWN, Comm. Timb. 1 (1932) 1; VESTAL, Philip. J. Sc. 64 (1937) 205; DEN BERGER, Med. Proefstat. Boschwezen 13 (1926) 118 (handlens). *D. excelsa* (= *Wormia excelsa*): M. & Js p. 69. *D. indica*: M. & Js p. 71; P. & B. p. 3. *D. pentagyna*: M. & Js p. 78; P. & B. p. 7. *D. obovata* (= *D. aurea*, non SMITH): M. & Js p. 76. *D. parviflora* GRIFF. (extra-Malaysian): P. & B. p. 6.

Vern. The Malay name 'simpur' (*simpoh*, *sẽmpur*, etc.) is in general use throughout W. Malaysia, some species being distinguished by epithets. In the Philippines 'katmon' is in general use.

Notes. Several classifications of the genus have been proposed, the basic one usually being in *Dillenia* and *Wormia* as separate genera or subgenera on account of the fruit (indehiscent *versus* dehiscent) by some authors, on account of the seed (exarillate *versus* arillate) by others. Other subgeneric classifications are based on the base of the petiole (amplexicaul *versus* non-amplexicaul) or on the structure of the androecium. It is impossible, however, to distinguish groups, characterized by the combination of more than one character; relationships within the genus are reticulate.

MARTELLI in BECC. Malesia 3 (1886) 150–167 was the first to unite the genera *Dillenia* and *Wormia*. He listed the species of both genera, but failed to make formally the new combinations, which have been ascribed to him by DUR. & JACKS. in the first supplement of Index Kewensis.

An important character of the androecium is the position of the anthers *in bud*; in a number of species the inner row is reflexed outwards. This may be permanent in anthesis. I have used the term 'straight' or 'straight or slightly curved' in all other cases.

The sequence of the species as adopted here reflects as far as possible their affinity.

#### KEY TO THE SPECIES

1. Basis of the petiole, later leaf-scar, completely amplexicaul.
2. Petiolar wings not constricted below the blade. Nervation of the wings not sharply separated from that of the blade, though often less distinct.
3. All stamens of approximately the same length. Flowers white . . . . . 1. *D. pteropoda*
3. Androecium consisting of small staminodes on the outside and stamens of different lengths, the length increasing towards the centre. Flowers yellow . . . . . 15. *D. suffruticosa*
2. Petiolar wings more or less constricted below the blade. Wings without distinct nervation or nervation different and independent from that of the blade.
4. Sepals 8 or more.
5. Sepals 8–9, not much different in size . . . . . 13. *D. marsupialis*
5. Sepals 11–17, distinctly increasing in size towards the centre . . . . . 14. *D. reifferscheidia*
4. Sepals 4–6, usually 5.
6. Stamens gradually decreasing in size towards the centre of the flower, the innermost ones staminodial . . . . . 12. *D. fagifolia*
6. Stamens all of approximately the same length or the innermost ones longer than the outer ones. If present, staminodes on the outside.
7. All stamens of approximately the same length.
8. Carpels hirsute.
9. Inflorescence simple, distinctly zigzag. Flower *ca* 6½ cm diam., yellow . . . . . 2. *D. beccariana*
9. Inflorescence usually composed, with only slightly zigzag axes. Flower *ca* 4 cm diam., white. . . . . 3. *D. albiflos*
8. Carpels glabrous.
10. Stigma distinct, knoblike. Flowers apetalous.
11. Petiolar wings semi-obcordate. Flowers rather large (e.g. stamens *ca* 9–11 mm long). . . . . 4. *D. serrata*
11. Petiolar wings broadly linear. Flowers smaller (e.g. stamens *ca* 6–7 mm long). . . . . 5. *D. celebica*

10. Stigma indistinct. Flowers with (caducous!) petals.
12. Upper part of petiolar wings persistent . . . . . 6. *D. ovalifolia*
12. Petiolar wings wholly caducous.
13. Carpels 4-6, usually 5 . . . . . 10. *D. fischeri*
13. Carpels 7-15.
14. Stamens with a 1-2 mm long acumen at the apex . . . . . 7. *D. papuana*
14. Connective at most slightly exceeding the anthercells.
15. Younger parts with dense villose indumentum . . . . . 8. *D. montana*
15. Younger parts glabrous or slightly hirsute.
16. Leaves ovate, *ca* 15-19-nerved. Sepals *ca* 25 by 22 mm . . . . . 9. *D. schlechteri*
16. Leaves elliptic, *ca* 6-9-nerved. Sepals *ca* 15 by 12 mm . . . . . 11. *D. quercifolia*
7. Innermost stamens longer than the outer ones, with the apical part reflexed outward *in bud*.
17. Apex of petiolar wing for *ca*  $\frac{1}{4}$  or more of its length exceeding its insertion to the petiole.
18. Flowers solitary on a pedicel, terminal. Apex of the petiolar wings rounded.
19. Flowers *ca* 6-8 cm diam. Carpels 6-9 . . . . . 16. *D. ochreata*
19. Flowers *ca* 20 cm diam. Carpels 14-16. . . . . 17. *D. megalantha*
18. Flowers in a 2-3-flowered raceme. Apex of the petiolar wings obtuse . . . . . 18. *D. talaudensis*
17. Apex of the petiolar wing not or hardly exceeding its insertion to the petiole.
20. Upper part of petiolar wings persistent . . . . . 19. *D. alata*
20. Petiolar wings wholly caducous, or at most small auricles persistent near the basis of the blade.
21. Petiolar wings elliptic-oblong. Flowers large, more than 10 cm diam. . . . . 20. *D. philippinensis*
21. Petiolar wings narrower. Flowers smaller, up to 10 cm diam.
22. Leaves elliptic to oblong, rather coriaceous, 5-8-nerved . . . . . 21. *D. diantha*
22. Leaves oblong to lanceolate, not coriaceous, 8-20-nerved.
23. Apex of the leaf acuminate. Plant often cauliflorous. Flowers whitish . . . . . 22. *D. bolsteri*
23. Apex acute. Plant not cauliflorous. Flowers yellow.
24. Leaves glabrous, 8-12-nerved . . . . . 23. *D. auriculata*
24. Leaves, at least the young ones, strigose on the nerves beneath, 10-18-nerved. . . . . 24. *D. castaneifolia*
1. Basis of the petiole, later leaf-scar, not completely amplexicaul, clasping up to  $\frac{3}{4}$  of the branch.
25. Inflorescence or solitary flowers typically terminal on leaf-bearing branches, often later lateral, leaf-opposed. Branches consequently sympodial.
26. Deciduous trees, with stilt-roots. Inflorescence appearing with the leaves, often immediately at its base with 2 or 3 branches, forming a loose cluster.
27. Carpels 4-6. Stamens all of approximately the same length. Flowers apetalous . . . . . 25. *D. eximia*
27. Carpels 7-10. Stamens not all of the same length. Flowers with (caducous!) petals.
28. Carpels 7-8. Petiole densely hirsute above, nearly glabrous beneath . . . . . 26. *D. borneensis*
28. Carpels 9-10. Petiole more densely hairy beneath than above . . . . . 27. *D. reticulata*
26. Evergreen trees, without stilt-roots. Inflorescence never branched immediately at its base. Flowers either solitary or in a raceme.
29. Stamens all of approximately the same length. Pedicel with 3 large verticillate bracteoles. Leaves densely velvety tomentose beneath . . . . . 28. *D. hookeri*
29. Stamens in 2 sharply separated groups of different length. No such bracteoles. Leaves not densely velvety tomentose beneath.
30. Carpels less than 12.
31. Carpels 6 or more.
32. Flowers in 4 to many-flowered inflorescences.
33. Inflorescence continuously growing. Upper internodes of inflorescence up to 1 cm long. Leaves 6-15 by 3-7 cm . . . . . 29. *D. luzoniensis*
33. Inflorescence with only short time of growth. Internodes of inflorescence longer. Leaves 15-30 by 7-10 cm . . . . . 30. *D. excelsa*
32. Flowers solitary or in up to 3-flowered inflorescences.
34. Leaves small (up to 7 by  $2\frac{1}{2}$  cm), lanceolate, coriaceous . . . . . 31. *D. sibuyanensis*
34. Leaves much larger.
35. Leaves elliptic with rounded apex. Flowers *ca* 16 cm diam . . . . . 32. *D. ovata*
35. Leaves oblong with obtuse to acute apex. Flowers *ca* 6 cm diam . . . . . 33. *D. sumatrana*
31. Carpels 4-5 . . . . . 34. *D. monantha*
30. Carpels 15-20 . . . . . 35. *D. indica*
25. Flowers either axillary on leaf-bearing branches or solitary or in fascicles on leafless branches.
36. Carpels 5-6. Flowers small, *ca*  $2\frac{1}{2}$ -3 $\frac{1}{2}$  cm diam.
37. Flowers axillary. Evergreen species with small leaves . . . . . 36. *D. pulchella*
37. Flowers in twig-born fascicles. Deciduous species with large leaves . . . . . 37. *D. pentagyna*
36. Carpels 9-11. Flowers large, *ca* 15 cm diam. . . . . 38. *D. obovata*

**1. *Dillenia pteropoda* (MIQ.) HOOGL. *comb. nov.***  
—*Wormia pteropoda* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 77.—*Dillenia papyracea* MERR. Philip. J. Sc. Bot. 9 (1915) 520; En. Philip. 3 (1923) 61.—*Dillenia megalophylla* MERR. Philip. J. Sc. 14 (1919) 421; En. Philip. 3 (1923) 60.—*Wormia papyracea* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.

Large tree, up to ca 40 m high, up to 1¼ m diam. Bark red-orange, peeling off in plates. Leaves elliptic, subcoriaceous, ca 17–21-nerved, 30–100 by 16–60 cm, blade with rounded to obtuse apex, obtuse to acute base and entire to slightly undulate-dentate margin. Petiole ca 5–10 cm long, wings up to 2½ cm broad, often caducous. Raceme simple, ca 4–7-flowered, up to 40 cm long. *Flowers* ca 10 cm diam. Sepals 5, ca 25–33 by 20–22 mm, slightly to densely velvety outside. Petals white, ca 45–50 by 30–32 mm. Stamens ca 700, 14–18 mm long. Carpels 8–12, ca 10 by 3½ mm, with ca 1 cm long styles, each with ca 25 ovules. *Fruit* dehiscent. Seeds surrounded by a basal, loose, somewhat cup-shaped aril.

Distr. *Malaysia*: Philippines (N. Luzon, Mindanao) and N. Moluccas (Halmahera, Batjan).

Ecol. In primary forests, often along streams, from sea-level up to 500 m.

Vern. Philippines: *tukoran* (Lan.), *malaigang* (Sul.). Moluccas: several names recorded, but none constant.

Notes. TEJSMANN 5886 from Batjan probably represents leaves from a coppice or from a young plant. The leaves are manifestly dentate and have a very short petiole. They are narrower than in the other specimens, ca 90 by 28 cm, with more lateral nerves (ca 40–50).

*Dillenia papyracea* MERR. and *D. megalophylla* MERR. differ only in the length of the pedicel; this does not seem sufficient argument to keep the two separated. From the Moluccas (including the type specimen) only sterile material is available.

**2. *Dillenia beccariana* MARTELLI in BECC. *Malesia* 3 (1886) 158; MERR. En. Born. (1921) 382.**—*Wormia beccariana* RIDL. Saraw. Mus. J. 1 (1913) 71.

Small tree, up to 6 m high. Leaves oblong to narrowly obovate, ca 20–30-nerved, 18–45 by 8–16 cm, with obtuse, often acuminate apex, rounded to obtuse base and slightly to manifestly dentate margin. Petiole ca 3–6 cm long; wings near their base 4–9 mm broad, gradually narrowing towards the base of the blade, coherent with the blade over a breadth of 1½–2 mm, when older loosening from the base of the blade and near the base of the petiole, but not caducous. Raceme up to 20-flowered, up to 60 cm long, distinctly zig-zag. *Flowers* ca 6½ cm diam. Sepals 5, ca 17–20 by 14–15 mm. Petals yellow, ca 33 by 22 mm. Stamens ca 130, 11–13 mm long. Carpels 5–6, ca 8–10 by 2 mm with ca 5 mm long styles, the carpels and the base of the styles densely covered with rigid, up to 2 mm long hairs; each with ca 20 ovules. *Fruit* dehiscent, but the carpels possibly only slightly spreading, the young fruit not enclosed by the sepals. Carpels 25 by 16 mm, 1–3-seeded. Seeds 4

by 2½ mm, with a 0.2–0.4 mm long membranaceous aril.

Distr. *Malaysia*: Borneo (Sarawak).

Ecol. In low altitude forests.

Vern. *Simpoh*, s. *délaki* (= male s.), *pētasi*.

Notes. Closely related to *D. albiflos* (RIDL.) HOOGL.

**3. *Dillenia albiflos* (RIDL.) HOOGL. *comb. nov.***—*Wormia albiflos* RIDL. J. Str. Br. R. A. S. 54 (1910) 6; Fl. Mal. Pen. 1 (1922) 9.—*Wormia beccariana* (non RIDL.) CORN. Gard. Bull. S.S. 10 (1939) 4; Wayside Trees Malaya (1940) 205.

Tree, up to 17 m high, with red bark, rarely with few stilt-roots. Leaves elliptic to oblong, ca 15–35-nerved, 20–40 by 9–20 cm, with rounded to acute, often slightly acuminate apex, rounded to obtuse base, and slightly undulate to manifestly dentate margin. Petiole ca 2½–4 cm long; wings near the base 5–11 mm broad, gradually narrowing towards the base of the blade, coherent with the blade over a breadth of 1–2 mm, when older loosening from the base of the blade and near the base of the petiole, but not caducous. Inflorescence pendent, up to 30-flowered, composed, being a raceme with the second and often third flower replaced by a secondary raceme, the branches slightly zig-zag. *Flowers* ca 4 cm diam. Sepals 5, ca 15–20 by 12–14 mm. Petals pale cream white, ca 20 by 13 mm. Stamens ca 160, 5½–8 mm long. Carpels 5–6, ca 4–5 by 1½ mm with ca 5 mm long styles, the carpels and the lower half of the styles rather densely covered with rigid, 0.4–0.7 mm long hairs, each with ca 10 ovules. *Fruit* dehiscent, the sepals in fruit enlarged to 25 by 15 mm. Carpels 10 by 12 mm, 1–2-seeded. Seeds 4 by 3 mm, finely echinate, with a 1 mm long membranaceous aril.

Distr. *Malaysia*: S. Malay Peninsula (E. Johore).

Ecol. In dry forest and on dry hillocks in swamps, at low altitude.

Vern. Only noted: *simpoh*.

Notes. Closely related to *D. beccariana* MARTELLI, from which it differs by the composed inflorescence, white, slightly smaller flowers and less densely hairy carpels with distinctly shorter hairs. According to CORNER (fieldnote) the biggest trees have the biggest leaves.

**4. *Dillenia serrata* THUNB. Trans. Linn. Soc. 1 (1791) 201; MIQ. Fl. Ind. Bat. 1, 2 (1859) 685; MERR. Int. Rumph. (1917) 368.**—*Sangius* RUMPH. Herb. Amb. 2 (1741) 142, t. 46.—? *Songium* RUMPH. Herb. Amb. 2 (1741) 140, t. 45.—? *Dillenia elliptica* THUNB. Trans. Linn. Soc. 1 (1791) 200; MARTELLI in BECC. *Malesia* 3 (1886) 161; MERR. Int. Rumph. (1917) 367; HEYNE, Nutt. Pl. (1927) 1071.

Rather large tree, up to 30 m high and 70 cm diam., with thinly scaling, reddish gray bark. Leaves oblong to lanceolate, 16–35-nerved, 20–45 by 8–19 cm, with rounded to acute apex, obtuse to acute base, and nearly entire to manifestly dentate margin. Petiole 2½–6½ cm long, with half-obcordate, caducous wings. Wings broadening towards the apex, the apex rounded, extending

distinctly above its insertion, at the basis 5–8, near the apex 15–30 mm broad, glabrous to densely sericeously hirsute beneath. Raceme 2–6-flowered, up to 15 cm long with straight to rather tortuous axis. *Flowers* probably apetalous, *ca* 7½ cm diam. Sepals 5, *ca* 40 by 25 mm, densely sericeously hirsute outside. Stamens *ca* 750, 9–11 mm long. Carpels *ca* 18–19, *ca* 4½ by 1½ mm, with *ca* 8 mm long, in the basal half parallel, in the apical half slightly spreading styles with a cushion-shaped stigma, stigma *ca* 0.4 mm thick and 1 mm diam.; each carpel with 5–9 ovules. *Fruit* indehiscent, yellowish, appressed globular, 3½ cm high, 6 cm diam. including the enclosing sepals. Sepals in fruit enlarged to 6½ by 5½ cm, at the base up to 3 mm thick, not completely covering the carpels at the apex. Carpels 25 by 16 mm, up to 5-seeded. Seeds black with reticulate surface, exarillate.

Distr. *Malaysia*: Celebes, Buton, and Muna Islands.

Ecol. In primary forests up to 180 m.

Uses. The fruit is eaten.

Vern. Celebes: *děngēn*, *d. bolusu*, *děngilo*, *dongi*, *wuadēngi*. Muna: *sonih*.

Notes. THUNBERG's binomial is wholly based on *Sangius* RUMPH. RUMPHIUS' description and plate are sufficient for the recognition of the species. *Dillenia elliptica* THUNB. is wholly based on *Songium* RUMPH. The identification of this species is much less certain, but the present species is the only one, that RUMPHIUS' description and plate can be compared with, except that the flowers in RUMPHIUS' species are solitary.

##### 5. *Dillenia celebica* HOOGL. *spec. nov.*

Tree, up to 30 m high, 50 cm diam., with small buttresses, greyish brown bark, slightly flaky in large plates, and greyish red heartwood. *Leaves* elliptic-oblong, *ca* 15–20-nerved; 13–18 by 6–10 cm, with obtuse to acute, often slightly acuminate apex, rounded-obtuse to obtuse base, and undulate to dentate margin. Petiole 4–8 cm long, with usually 2½–5 mm, rarely up to 10 mm broad wings; wings with slightly auriculiform apex, caducous. Raceme 1–5-flowered, up to at least 4 cm long. *Flowers* apetalous, *ca* 4½ cm diam. Sepals 5, *ca* 21–25 by 16–19 mm, sericeous outside. Stamens *ca* 300, 6–7 mm long. Carpels *ca* 11, *ca* 8 by 3½ mm, with *ca* 7 mm long spreading styles with a cushion-shaped stigma, stigma *ca* 0.3 mm thick and 0.8 mm diam.; each carpel with 3–4 ovules. *Fruit* unknown.

Distr. *Malaysia*: N. and C. Celebes.

Uses. The wood is used for house-building.

Notes. Closely related to *D. serrata*, also endemic of Celebes, from which it differs by the much longer petioles, the shape of the petiolar wings, and the much smaller number of carpels. The 2 species are the only ones, where a distinct, knoblike stigma is found in *Dillenia*.

##### 6. *Dillenia ovalifolia* HOOGL. *spec. nov.*—*Dillenia alata* MARTELLI in BECC. Malesia 3 (1886) 157, *quoad* descr.

Tree, up to 30 m high, 60 cm diam., with abso-

lutely glabrous branches. *Leaves* rather coriaceous, elliptic to nearly orbicular, 8–13-nerved, 7–27 by 6–22 cm, with rounded apex and base and slightly undulate margin; in bud folded thus as to leave a faint, longitudinal line between each pair of lateral nerves. Petiole 4½–10 cm long, with 5–10 mm broad wings, with a horseshoe-shaped cushion at the insertion. Wings linear with rounded apex, partly caducous, the part falling off being the whole breadth at the base of the petiole, gradually narrowing to a wholly persistent wing at ⅓–¾ of the petiole; apex auriculate, the auricles of both wings coherent above the petiole, extending slightly above the blade. *Flowers* solitary, terminal, soon lateral, leaf-opposed. Peduncle 5½–7 cm long, at the base triangular in transverse section. Sepals 5, the outer 2 *ca* 25–28 by 19–20 mm, the inner 3 35–40 by 20–22 mm, glabrous or not. Petals white, at least 25 by 18 mm. Stamens *ca* 900, 5–7 mm long, with a 0.7–0.8 mm long acumen. Carpels 7–8, glabrous, *ca* 9 by 2½ mm with 13 mm long styles, each with *ca* 8 ovules. *Fruit* dehiscent. Carpels *ca* 17 by 10 mm, 1-seeded. Seeds *ca* 5 by 3½ mm, enclosed by a 3 mm long aril.

Distr. *Malaysia*: Moluccas (Halmahera, Morotai) and Japen Island near NW. New Guinea (Geelvink-Bay).

Ecol. In primary forest, from sea-level to 1000 m.

Vern. Japen Island: *karoe ai* and *wadajouw*.

Notes. For the identity of *Dillenia alata* MARTELLI see p. 164. The impression on the leaf, caused by the folding in bud, has not been noted so clearly in any other *Dillenia*.

The specimens from the Moluccas differ from those from Japen Island, which are entirely glabrous, by a dense short sericeous indumentum on the young branches, on the basal part of the nerves on the lower surface of the leaves, on the lower side of the petiole, on the peduncle, and on the outer side of the sepals. They represent a distinct variety, *var. sericea* HOOGL. *var. nov.*

7. *Dillenia papuana* MARTELLI in BECC. Malesia 3 (1886) 156.—*Wormia pteropoda* (non MIQ.) BOERL. Cat. Bog. (1899) 5.—*Dillenia calothyrsa* DIELS, Bot. Jahrb. 57 (1922) 437.—*Wormia calothyrsa* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.—*Wormia papuana* GILG & WERDERM. l.c.—*Wormia macrophylla* (non G.&W.) A. C. SMITH, J. Arn. Arb. 22 (1941) 498.—Fig. 8, 9.

Tree, up to 30 m high, 1 m diam., often with buttresses, with pale reddish brown bark peeling off in very thin papery scales. *Leaves* elliptic to ovate, *ca* 20–25-nerved, 15–40 by 10–35 cm, on young trees and saplings narrower, *ca* 30–35-nerved, 50–100 by 25–50 cm, with rounded to obtuse apex, rounded base, and undulate to slightly dentate margin. Petiole 4–8 cm long, on young trees and saplings up to 10 cm, with half-obcordate, rarely oblong, caducous wings. Wings usually broadening towards the apex, the apex rounded, extending distinctly above its insertion, at the basis 6–10, near the apex up to 35 mm broad. Raceme 4–7-flowered, up to 8 cm long with tortuous axis.





Fig. 9. *Dillenia papuana* MARTELLI. Trees ca 30 m tall, ca 1 m diam., in 2 m deep inundated flood-plain forest. This type of forest was inundated Jan. to May 1939, Bernhard Camp, Idenburg River, West New Guinea (BRASS, ARCHBOLD Expeditions).

Flowers probably never quite expanding, the sepals only slightly diverging, the petals falling off without spreading. Sepals 5, *ca* 30–40 by 25–40 mm. Petals yellow, cucullate when falling, 25–45 by 12–25 mm. Stamens *ca* 185–250, 13–24 mm long (but in a single flower all of approximately the same length), with a 1–2 mm long, acute acumen above the anthercells. Carpels 10–15, *ca* 10–15 by 2–3 mm, with 11–15 mm long styles, each with *ca* 25 ovules. Fruit dehiscent. Carpels 25–35 by 16–24 mm, one-seeded. Seeds 6 by 5 mm, black, enclosed by a rather thick fleshy aril.

Distr. *Malaysia*: Tanimbar and Aru Islands, New Guinea, and islands in the Geelvink Bay.

Ecol. In primary forest at low altitudes, on dry or temporarily flooded soil (fig. 9), once collected at *ca* 2000 m.

Uses. Said to supply a good timber.

Vern. Tanimbar Islands: *kamjemeje*. New Guinea: several noted, but none constant.

**8. *Dillenia montana* DIELS, Bot. Jahrb. 57 (1922) 437.**—*Wormia montana* GILG & WERDERM. in ENGL. & PR., Nat. Pfl. Fam. ed. 2, 21 (1925) 35.

Tree, *ca* 35 m high with 15 m clear trunk, *ca* 40 cm diam., with reddish brown papery scaly bark and brown wood. Younger branches densely villose. Leaves elliptic to ovate-elliptic, 9–14-nerved, *ca* 10–21 by 6–17½ cm, with rounded, slightly acuminate apex, rounded base, and dentate margin, more or less villose on both sides. Petiole 2½–7 cm long, with linear-oblong, caducous wings. Raceme 2-flowered, up to 6 cm long, with densely villose axis. Flowers incompletely known, possibly never quite expanding. Sepals 5, the two outermost ones *ca* 30 by 30 mm, the three innermost ones *ca* 35 by 30 mm, the outer ones slightly villose outside. Petals 5, yellow. Stamens *ca* 90, 20 mm long. Carpels 8–9, *ca* 18 by 4 mm, with 9 mm long, only slightly spreading styles; each carpel with 13–14 ovules. Fruit unknown.

Distr. *Malaysia*: NE. New Guinea (Central Highlands and Hunstein Range).

Ecol. In forests, 1350 and 2000 m.

Vern. *Burra* (Arona), *warawaka* (Aiyura).

Notes. The species is closely related to *Dillenia schlechteri* DIELS and *D. papuana* MARTELLI.

**9. *Dillenia schlechteri* DIELS, Bot. Jahrb. 57 (1922) 438.**—*Dillenia alata* var. *macrophylla* LAUT. Bot. Jahrb. 45 (1911) 362.—*Dillenia macrophylla* DIELS, Bot. Jahrb. 57 (1922) 437.—*Wormia schlechteri* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.—*Wormia macrophylla* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.—*Wormia nitida* A. C. SMITH, J. Arn. Arb. 22 (1941) 499.

Large tree, up to 35 m high, 2 m diam., with buttresses to 3 m tall, 1 m long; bark reddish brown, flaky; wood reddish brown, hard and heavy. Leaves broadly ovate, *ca* 15–21-nerved, 11–30 by 7½–21 cm, with rounded apex, rounded, slightly cordate base, and slightly undulate margin. Petiole 4–9 cm long, with 4–8 mm broad wings.

Raceme 2–6-flowered, up to *ca* 7 cm long. Flowers probably never quite expanding, the sepals only slightly diverging, the petals falling off without spreading. Sepals 5, *ca* 25 by 22 mm. Petals bright yellow, cucullate when falling, *ca* 33 by 28 mm. Stamens *ca* 100, 14–17 mm long. Carpels 8–11, *ca* 8–9 by 2–2½ mm, with 10–12 mm long styles, each with *ca* 14–18 ovules. Fruit dehiscent, the sepals enlarged to *ca* 35 by 30 mm. Carpels *ca* 25 by 18 mm, 1-seeded. Seeds *ca* 4 by 3 mm, enclosed by a 2½ mm long aril.

Distr. New Ireland, in *Malaysia*: E. New Guinea.

Ecol. In primary forests, in New Guinea found only between 1300 and 1700 m, in New Ireland at low altitude.

Uses. The durable wood is used for building purposes.

Vern. Once noted: *manaya* (Kuni language).

**10. *Dillenia fischeri* MERR. Philip. J. Sc. Bot. 9 (1915) 518; En. Philip. 3 (1923) 60.**—*Wormia fischeri* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.

Tree, up to 20 m high. Leaves elliptic-oblong to oblanceolate, coriaceous, *ca* 7–11-nerved, 6½–14 by 2.8–6½ cm, with rounded apex, obtuse to rounded base, and nearly entire to dentate, mainly in the upper part of the leaf, margin. Petiole 1½–3 cm long, with linear, 1 mm broad, caducous wings. Inflorescence terminal on the leaf-bearing branches or lateral on the older branches in the axil of a leaf-scar; raceme 2–6-flowered, sometimes with one lateral branch, up to 5 cm long. Flowers *ca* 6 cm diam., on a 3–6 cm long pedicel. Sepals 4–6, usually 5, *ca* 13–16 by 8–12 mm. Petals as many as sepals, white, *ca* 30 by 14 mm. Stamens *ca* 120–160, the outer ones slightly longer, 9 mm, than the inner ones, 7 mm. Carpels 4–6, usually 5, *ca* 7 by 2½ mm, with 5–8 mm long styles, each with 8–10 ovules. Fruit unknown.

Distr. *Malaysia*: Philippines (known only from Mindanao, Butuan subprov.).

Ecol. In semi-open forests at low altitude.

**11. *Dillenia quercifolia* (WHITE & FRANCIS ex LANE POOLE) HOOGL. comb. nov.**—*Wormia quercifolia* WHITE & FRANCIS ex LANE POOLE, For. Res. Terr. Papua & N. Guinea (1925) 116; WHITE & FRANCIS, Proc. Roy. Soc. Queensl. 38 (1926) 242, f. 9 (1927).

Large tree, *ca* 35 m high with 28 m clear trunk *ca* 1.2 m diam., with reddish, papery scaly bark and yellow to rose-brown wood. Leaves elliptic 6–9-nerved, 8–15 by 4½–12 cm, with obtuse to rounded, minutely acuminate apex, obtuse to rounded base, and more or less undulate margin, glabrous. Petiole 3–4 cm long, the wings 3–7 mm broad. Raceme 2–4-flowered, up to *ca* 5 cm long with tortuous axis. Flowers *ca* 4–5 cm diam. Sepals 5, 12–16 by 10–13 mm. Petals not known from open flowers. Stamens *ca* 60, 10 mm long. Carpels 7–10, usually 8, *ca* 5 by 2 mm, with 7 mm long style, each with 8–9 ovules. Fruit unknown.

Distr. *Malaysia*: New Guinea.

Ecol. 'Flowers July to August in N. Division' (LANE POOLE).

Vern. *Lalagi* (Buna & Binandele).

**12. *Dillenia fagifolia* HOOGL. spec. nov.**

Large tree, nearly 50 m high with 30 m clear trunk, *ca* 1 m diam., with branched buttresses and reddish brown, papery scaly bark; wood pinkish or pale red brown. *Leaves* elliptic, 17–19-nerved, 12½–16 by 8–10 cm, with obtuse apex, obtuse to rounded base, and entire to very slightly undulate margin. *Petiole* 5–5½ cm long, with 7–8 mm broad wings. *Raceme* 6-flowered, with tortuous, *ca* 6 cm long axis. *Flower* known only in bud. *Sepals* 5, the outermost one (and probably in the open flower the other ones of approximately the same size) 22 by 25 mm. *Petals* present. *Stamens* in 2 rather distinct groups, the outer ones, *ca* 60, fertile, decreasing in size towards the centre, 5–2½ mm long, with 0.3 mm long acute acumen; the inner ones, *ca* 90, sterile, *ca* 1 mm long. *Carpels* 12, in bud *ca* 2 by 1 mm, with 1 mm long style, each with 12–14 ovules. *Fruit* unknown.

*Distr. Malaysia:* E. New Guinea (once collected near Aitape, L. S. SMITH, N.G.F. 1229).

Vern. *Ainedin* (But near Wewak).

*Notes.* The species is only very imperfectly known. The structure of the androecium, however, is so characteristic, that the said specimen certainly represents a new species. This type of androecium was not yet known in *Dillenia*.

**13. *Dillenia marsupialis* HOOGL. spec. nov.—*Dillenia ochreatea* (non MARTELLI) MERR. En. Philip. 3 (1923) 61.**

Small tree. *Leaves* elliptic to oblong, *ca* 13–16-nerved, 12–20 by 5½–10 cm, with rounded or obtuse, ± distinctly acuminate apex, obtuse to acute base, and nearly entire to distinctly dentate margin, entirely glabrous. *Petiole* 1½–4 cm long, with nearly circular to obovate wings. *Wings* up to 35 by 22 mm with rounded apex and entire margin, glabrous, wholly caducous. *Flowers* terminal, solitary, *ca* 10 cm diam. *Sepals* 8–9, the outermost ones only slightly smaller than those towards the centre, 3½–4 by 2½–3 cm. *Petals* unknown. *Stamens* in 2 groups, the outer group *ca* 260, *ca* 13 mm long, straight in bud, the inner group *ca* 75, *ca* 23 mm long, with their apex reflexed in bud. *Carpels* *ca* 15, *ca* 12 by 2 mm, with *ca* 20 mm long, recurved styles, each with 7–10 ovules. *Fruit* indehiscent, subglobose, 4–5 cm diam. including the enclosing sepals. *Carpels* *ca* 25 by 12 mm, 1–2-seeded. Seeds enclosed by a membranaceous aril.

*Distr. Malaysia:* Philippines (Luzon, Panay, and Catanduanes).

Ecol. On forested slopes, up to 1200 m alt.

*Notes.* Closely related to *Dillenia reifferscheidia* VILLAR, not to *D. ochreatea*, though its leaves resemble very much that species. It is easily recognized from the latter species by the larger number of sepals and larger flowers and fruits.

**14. *Dillenia reifferscheidia* VILLAR, Nov. App. (1880) 3; BLANCO, Fl. Filip. ed. 3 (1880) t. 344; VIDAL, Rev. Pl. Vasc. Filip. (1886) 38; MERR. En. Philip. 3 (1923) 61.—*Reifferscheidia speciosa* PRESL, Rel. Haenk. 2 (1836) 74, t. 62.—*Dillenia speciosa* GILG in ENGL. & PR. Nat. Pfl. Fam. 3, 6a (1893) 124, non THUNB. (1790).—*Dillenia reifferscheidia* var. *rosea* ELM. Leaf. Philip. Bot. 3 (1923) 61.**

Tree, up to *ca* 11 m high, 60 cm diam. *Leaves* elliptic to obovate, *ca* 14–20-nerved, *ca* 15–40 by 10–30 cm, with rounded apex and base and slightly to manifestly dentate margin. *Petiole* 3–4 cm long, strigose beneath, with obovate wings. *Wings* *ca* 3–5 by 2¼–4 cm, with rounded apex and entire margin, more or less woolly hairy beneath, wholly caducous. *Flowers* terminal, solitary or less often 2–3 together, if solitary with 2–5 or without bracteoles, if 2 (resp. 3) 1 (resp. 2) with and 1 without bracteoles; *ca* 17½ cm diam. *Sepals* 11–17, the outer ones *ca* 20 by 22 mm, the inner ones *ca* 65 by 40 mm. *Petals* white or, rarely, rose red (var. *rosea* ELM.), *ca* 9 by 5 cm. *Stamens* in 2 groups, outer group *ca* 375, 11 mm long, straight in bud, inner group *ca* 60, 25 mm long, with their apex reflexed in bud. *Carpels* *ca* 15, *ca* 12 by 3 mm, with *ca* 18 mm long, recurved styles, each with 9–12 ovules. *Fruit* indehiscent, subglobose, 5–8 cm diam. including the enclosing sepals. *Carpels* 20–25 by 10–12 mm, 1–4-seeded. Seeds black, enclosed by a membranaceous aril.

*Distr. Malaysia:* Philippines (from the S. half of Luzon to Mindanao, not in the Westernmost islands).

Ecol. In primary forests in humid regions with abundant rainfall, from low altitude to *ca* 1000 m.

Uses. Construction timber tree. The fruit makes a good preserve.

Vern. *Balali* (Bik.), *katmón* (Tag., P. Bis.), *k. kadlagan* (Bik.), *k. kalabáu* (Tag.), *paláli* (Bik.).

**15. *Dillenia suffruticosa* (GRIFF.) MARTELLI in BECC. Malesia 3 (1886) 163; MERR. En. Born. (1921) 384; DE WIT, Bull. Bot. Gard. Btzg, III, 18 (1949) 208.—*Wormia suffruticosa* GRIFF. Not. 4 (1854) 706; Ic. Pl. As. (1854) t. 649; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 35; KING, J. As. Soc. Beng. 58, 2 (1889) 364; RIDL, J. Str. Br. R. A. S. 54 (1910) 5; BACK, Schoolfl. Java (1911) 10; KOORD. Exk. Fl. Java 2 (1912) 601; BLAAUW, Trop. Nat. Schets. Kleur. (1913) 17, t. 12; RIDL, Fl. Mal. Pen. 1 (1922) 8; BURK. Dict. (1935) 2265; CORN. Gard. Bull. S. S. 10 (1939) 9; Wayside Trees Malaya (1940) 207, pl. 53; BACK, Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 4.—*Wormia excelsa* (non JACK) Hk. f. & Th. Fl. Ind. 1 (1855) 67.—*Wormia subseissilis* MIQ. Fl. Ind. Bat. Suppl. (1860) 619; Ann. Mus. Bot. Lugd. Bat. 1 (1864) 315, t. 9; *ibid.*, 4 (1868) 77; RIDL, J. Str. Br. R. A. S. 54 (1910) 4; Fl. Mal. Pen. 1 (1922) 7, f. 2.—*Wormia burbidgei* HOOK. f. Bot. Mag. (1880) t. 6531.—*Dillenia burbidgei* GILG in ENGL. & PR. Nat. Pfl. Fam. 3, 6 (1893) 123.—*Wormia subseissilis* var. *borneensis* RIDL, J. Str. Br. R. A. S. 54 (1910) 6.—*Dillenia suffruticosa* var. *borneensis* RIDL, Saraw. Mus. J. 1**

(1913) 71; MERR. EN. BORN. (1921) 384.—*Dillenia* sp. DE VOOGD. Trop. Natuur 21 (1932) 61.—**Fig. 10.**

Large shrub, up to 10 m high. *Leaves* elliptic to obovate, *ca* 12–20-nerved, *ca* 15–25 by 8–12 cm, blade with ± obtuse apex and base and entire to dentate margin, glabrous above or sometimes

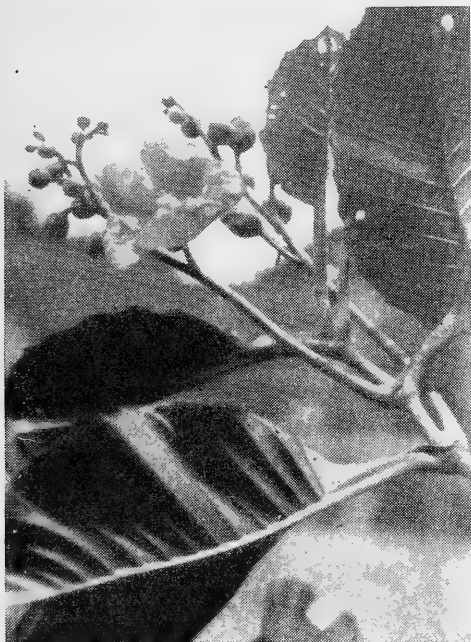


Fig. 10. *Dillenia suffruticosa* (GRIFF.) MARTELLI, Palembang (DE VOOGD).

slightly woolly on young leaves, beneath slightly to densely woolly on the lateral nerves, on both sides of the central nerve (continuing on the petiole), and along the line which delimits the bud-enclosing part of the leaf-basis. Petiole *ca* 2–6 cm long with up to 1½ cm broad, usually persistent wings. Raceme usually simple, sometimes composed, *ca* 5–12-flowered. *Flowers* *ca* 8–11 cm diam. Sepals 5, *ca* 15–22 by 8–12 mm, in fruit enlarged to *ca* 18–25 by 10–15 mm. Petals bright yellow, *ca* 40–50 by 25–30 mm. Staminodes *ca* 100, 6 mm long. Stamens *ca* 175, the outer ones 8 mm long, straight in bud, the inner ones 13 mm long, with their apex reflexed in bud, with intermediate lengths. Carpels 5–8, usually 7, *ca* 5 by 2 mm, with yellowish white, *ca* 1 cm long styles, each with 7–10 ovules. *Fruit* dehiscent. Carpels red, *ca* 20–25 by 10–16 mm, each 1–4-seeded. Seeds brown or black, with a membranaceous, scarlet aril.

Distr. *Malaysia*: Sumatra (Palembang), Malay Peninsula, Riouw- and Lingga-Archipelagos, Natuna, Banka, Billiton, W. Java, and Borneo. Contrarily to the opinion of DE WIT I do not believe that the species is indigenous in W. Java. All collections are made within a relatively small area

around Bogor and of fairly recent date, all made at least 30 years after the introduction of the species into the Botanic Garden. Moreover, the species easily naturalizes, *e.g.* in Jamaica, where it has become abundant.

Ecol. In marshes, along streams, and on the margin of forests, often forming thickets, from sea-level up to 500 m. Flowering continuously, each flower open for one day only, between 2 flowers of the same raceme a difference of *ca* 3–4 days. Fruit ripe after 36 days (CORNER, 1940); seeds eaten by birds.

Uses. Sometimes planted as an ornamental.

Vern. Malay Peninsula: *simpoh*, *s. ayer* (= water s.), *s. gajah* (= elephant or big s.), *s. pasir* (= sand s.). Natuna: *simpor*. Banka: *simpong*, *sipor*, *kaju simpur* (= tree s.), *kembang mēsimpur* or *masimpur* (= flower s.), *mininpor*, *simpor pram-puan* (= female s.). Billiton: *simpur*. Borneo: *dungin* (Dusun), *simpor*, *simpur*, *s. bini* (= female s.), *s. ayer* (Mal.).

**16. *Dillenia ochreate* (MIQ.) TEJISM. & BINN. Cat. Hort. Bog. (1866) 178, *nomen*, ex MARTELLI in BECC. Malesia 3 (1886) 178; HEYNE, Nutt. Pl. (1927) 1072.—*Wormia ochreate* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 77, t. 1; KOORD. Meded. Pl. T. 19 (1898) 327.**

Tree, up to 15 m high and 35 cm diam. *Leaves* ovate or elliptic-oblong, *ca* 15–18-nerved, 10–20 by 4½–10 cm, with acute, often slightly acuminate, less often obtuse apex, rounded to acute base, and nearly entire to slightly dentate margin, glabrous. Petiole *ca* 16–20 mm long, with broad half-obcordate wings; wings *ca* 16–18 by 13–15 mm, with entire margin, glabrous, caducous. *Flowers* solitary, terminal, *ca* 6–8 cm diam. Sepals approximately circular, 2–2½ cm diam., glabrous. Petals yellow, 4 by 3½ cm. Stamens *ca* 165, the outermost ones *ca* 7½ mm long, straight in bud, the innermost ones *ca* 12 mm long, with the apex reflexed in bud, with intermediate lengths. Carpels 6–9, *ca* 7 by 2½ mm, with 7 mm long styles; each with 8 ovules. *Fruit* indehiscent, pale green, slightly depressed-globular, *ca* 32 mm diam., 26 mm high. Carpels very slightly spirally twisted, *ca* 15 by 12 mm, 1-seeded. Seeds *ca* 5 by 4 mm, very finely densely echinate, enclosed by a 10 mm long, rather fleshy aril.

Distr. *Malaysia*: NE. Celebes (Minahasa).

Ecol. In forests from low altitude to 800 m, often found on volcanic sand.

Vern. *Kelemur* (Alf.); some other names noted, but not constant.

**17. *Dillenia megalantha* MERR. Philip. J. Sc. Bot. 9 (1914) 519; WESTER, Philip. Agr. Rev. 14 (1921) 242; MERR. EN. Philip. 3 (1923) 60.—*Dillenia mindanaensis* ELM. Leaf. Philip. Bot. 7 (1915) 2611; WESTER, Philip. Agr. Rev. 14 (1921) 287, t. 27b; MERR. EN. Philip. 3 (1923) 60.—*Wormia megalantha* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.**

Tall tree, up to 20(–40?) m high, 40 cm diam., with brown and gray bark, scaling off in thin plates.

*Leaves* oblong to oblanceolate, *ca* 25–35-nerved, 25–70 by 8–25 cm, with acute, often slightly acuminate apex, rounded base, and manifestly dentate margin. Petiole  $2\frac{1}{2}$ –5 cm long, with obovate wings; wings  $2\frac{1}{2}$ –5 by  $1\frac{1}{2}$ –3 cm (on saplings up to 10 by 6 cm), with rounded apex and slightly to manifestly dentate margin, caducous. *Flowers* solitary, terminal, *ca* 20 cm diam. Sepals elliptic, 25–40 by 20–30 mm. Petals yellow, *ca* 10 by  $7\frac{1}{2}$  cm. Stamens in 2 distinct groups, the outer ones *ca* 600, 10–12 mm long, straight in bud, the inner ones *ca* 100, 17–25 mm long, with their apex reflexed in bud; on the outside a small number of staminodes, 6–14 mm long. Carpels 14–16, *ca* 10 by 3 mm with 22 mm long styles, each with *ca* 25 ovules. *Fruit* indehiscent,  $5$ – $7\frac{1}{2}$  cm diam. including the enclosing sepals, which are *ca* 7 by 5 cm, at the basis 8 mm thick. Carpels *ca* 25 by 11 mm, 1-seeded. Seeds obovoid, 6 by 4 mm, finely shortly echinate, with an 8 mm long, membranaceous aril.

Distr. *Malaysia*: Philippines (S. Luzon to Mindanao, absent from N. Luzon to Palawan).

Ecol. In primary forests at low altitude, up to 1000 m.

Uses. The fruit is eaten.

Vern. *Kalambog* (Bag.), *katmón* (Bik., S.L. Bis., Bag.), *katmón-bayani* (Tag.), *lumbóg* (Sub.), *palálí* (Sub.).

#### 18. *Dillenia talaudensis* HOOGL. *spec. nov.*

Small tree, *ca* 8 m high, 11 cm diam.; branches glabrous. *Leaves* elliptic or ovate, 18–20-nerved, 20–30 by 14–21 cm, with obtuse to rounded apex with small acumen, rounded base, and slightly dentate margin. Petiole  $3\frac{1}{2}$ –5 cm long, with caducous wings. Wings obovate, up to 12 mm broad, the apex extending about  $\frac{1}{2}$  cm above the insertion, ending into a mucronate acumen. Raceme 2–3-flowered, with 10–12 cm long axis. *Flowers* known only in bud and as young fruit, on a short, thick pedicel. Sepals 5, the outer 2 *ca* 21 by 19 mm, the inner 3 *ca* 30 by 23 mm. Petals in bud up to 22 by 15 mm. Stamens in 2 distinct groups, the outer ones, *ca* 250, *ca* 6 mm long in bud, 10 mm in the young fruit, straight in bud, the inner ones, *ca* 80, *ca* 11 mm long in bud, 19 mm in the young fruit, with their apex reflexed in bud. Carpels 14, *ca* 5 by 1.3 mm in bud, with 11 mm (in the young fruit 20 mm) long styles, each with 8–11 ovules. *Fruit* unknown.

Distr. *Malaysia*: Salibabu Island, Talaud group N of Celebes, once collected.

Ecol. Common in secondary forest.

Uses. The fruit is eaten uncooked.

Vern. *Luaran'a*.

19. *Dillenia alata* (R.Br. ex DC.) MARTELLI in BECC. *Malesia* 3 (1886) 157.—*Wormia alata* R.Br. ex DC. Syst. 1 (1818) 434; Prod. 1 (1824) 75; BTH. Fl. Austr. 1 (1863) 16; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 78; F.v.M. Fragm. 7 (1871) 124; BAIL. Queensl. Fl. 1 (1899) 10; BANKS & SOL. Ill. Bot. Capt. Cook's Voy. 1 (1900) 5, t. 1; BAIL. Compr. Cat. Queensl. Pl. (1909) 18, pl. 2; BRASS, J. Arn. Arb. 19 (1938) 186, pl. 222.—*Lenidia alata*

POIR. Dict. Sc. Nat. 25 (1822) 448.—*Wormia apetalata* GAUD. in FREYC. Voy. Bot. (1826) 476, t. 99.—*Dillenia apetalata* MARTELLI ex DUR. & JACKS. Ind. Kew. Suppl. 1 (1902) 136.

Tree, up to 20 m high, 60 cm diam., with reddish brown bark peeling off in thin papery flakes, and crooked branches. *Leaves* ovate to elliptic, *ca* 8–14-nerved, 8–25 by 5–15 cm, with rounded apex and base and entire, slightly recurved margin. Petiole  $2\frac{1}{2}$ –4 cm long, with 2–6 mm broad wings; wings narrowing towards the base of the blade, partly caducous, leaving behind a  $\frac{1}{2}$  mm broad part on the lower  $\frac{1}{2}$ – $\frac{3}{5}$  of the petiole, the wing on the upper  $\frac{2}{5}$ – $\frac{1}{4}$  permanent. Raceme 2–4-flowered. *Flowers* *ca*  $7\frac{1}{2}$  cm diam. Sepals 5, the outer 2 circular, 1.3 cm diam., the inner 3 elliptic-ovate, 2 by  $1\frac{1}{2}$  cm. Petals yellow, 40 by 25 mm. Stamens in 2 distinct groups, the outer ones *ca* 100, 7–8 mm long, straight in bud, the inner ones *ca* 18, 11–13 mm long, with their apex reflexed in bud. Carpels 6–8, deep crimson, *ca* 10 by 4 mm, with red, *ca* 14 mm long styles, each with *ca* 8 ovules. *Fruit* dehiscent. Carpels 18–20 by 10–14 mm, 1–3-seeded. Seeds 4 by 3 mm, black, enclosed by a membranaceous, waxy white aril.

Distr. E. Coast of N. Queensland, S to about 20° S, in *Malaysia*: Waigeo and S. New Guinea.

Ecol. In *Malaysia* found in savannah forests.

Notes. The first description of the species was that by DC. (1818) *l.c.* under the name *Wormia alata* R.Br., citing *Dillenia alata* BANKS as a synonym. The first legitimate transfer to *Dillenia* was effected by MARTELLI (1886), who, however, described a specimen of *Dillenia ovalifolia* HOOGL.

20. *Dillenia philippinensis* ROLFE, J. Linn. Soc. 21 (1884) 307; VIDAL, Rev. Pl. Vasc. Filip. (1886) 37; MERR. Fl. Manila (1912) 331; WESTER, Philip. Agr. Rev. 8 (1915) 104, t. 7a; MERR. Sp. Blanc. (1918) 263; BROWN, Minor Prod. Philip. For. 2 (1921) 338, f. 62, 63; MERR. En. Philip. 3 (1923) 61.—*Dillenia indica* (non L.) BLANCO, Fl. Filip. (1837) 472; VILLAR, Nov. App. (1880) 3.—*Dillenia speciosa* (non THUNB.) BLANCO, Fl. Filip. ed. 2 (1845) 329, ed. 3, 2 (1878) 244, atlas t. 199.—*Dillenia catmon* ELM. Leaf. Philip. Bot. 7 (1915) 2610; MERR. En. Philip. 3 (1923) 59.

Tree, up to 17 m high, 60 cm diam., with rather low-attached crown, reddish bark, and dark wood. *Leaves* elliptic or ovate to lanceolate, *ca* 10–15-nerved, 8–25 by 6–16 cm, chartaceous, with rounded to obtuse, often slightly acuminate apex, rounded to obtuse base, and slightly dentate or undulate margin. Petiole  $3\frac{1}{2}$ –5 cm long, with half-elliptic to half-oblong, 3–12 mm broad, caducous wings. Inflorescence a 1–2-, rarely 3-flowered raceme with 5–16 cm long axis. *Flower* *ca* 10–15 cm diam. Sepals 5, the two outer ones *ca* 1.8 by 1.8 cm, the 3 inner ones  $2$ – $2\frac{1}{2}$  by 1.7–2 cm. Petals white, 4–7 by 2–5 cm. Stamens in 2 distinct groups, the outer ones, *ca* 230, yellow, 11 mm long, straight in bud, the inner ones, *ca* 40, purplish, 15–23 mm long, with their apex reflexed in bud. Carpels 10–12, 7–9 by  $2\frac{1}{2}$ –3 mm, with linear, *ca* 17 mm long, spreading styles, each with 10–12 ovules. *Fruit* in-

dehiscent, depressed-globose, 4–5 cm high, 5–6 cm diam. including the enclosing slightly fleshy sepals. Carpels slightly spirally twisted, fleshy, 20 by 13 mm, 1–4-seeded. Seeds 5 by 3 mm, very finely echinate, at the base enclosed by a 2 mm long, membranaceous aril.

**Distr. Malaysia:** Philippines from the Babuyan Islands to the Sulu Archipelago, not in Palawan.

**Ecol.** Common in forests at low and medium altitudes, rarely above 1000 m, once collected at 1800 m.

**Uses.** The pulp from the fruit is eaten; it makes an excellent sauce or jam and is used, mixed with sugar, as a cough cure. It is also used for cleansing the hair. A red dye is obtained from the bark.

**Vern.** The following vernaculars are in use: *balale*, *balobayauak*, *bihis*, *biskan*, *bolobayauak*, *cachuchio*, *dingin*, *kalambugui*, *kambug*, *katmón*, *kulambug*, *paláli*, *palále*, and *pamamalien*, the most frequently used ones being *katmón* and *palale*.

**Notes.** MERR. (1923, l.c.) distinguishes a *var. pubifolia*, which differs from the typical form by the hirsute inflorescences and sepals and the pilose underside of the leaves. The differences are only very slight.

## 21. *Dillenia diantha* HOOGL. *spec. nov.*

Tree, up to 25 m high, 60 cm diam. *Leaves* elliptic to oblong, 5–8-nerved, *ca* 6–12 by 4½–7½ cm, with rounded to obtuse or slightly emarginate apex, rounded to obtuse base, and slightly undulate to dentate margin, glabrous. Petiole 1½–4 cm long, with linear-lanceolate, 1–2 mm broad wings; wings with rounded or auriculiform apex, caducous. Inflorescence a 2-flowered raceme, less often flowers solitary; axis 1½–4 cm long. *Flowers* *ca* 9 cm diam. Sepals 5, elliptic, *ca* 22 by 15 mm. Petals yellow, *ca* 45 by 29 mm. Stamens in 2 distinct groups, the outer ones *ca* 155, 9–10 mm long, straight in bud, the inner ones *ca* 20, 13–15 mm long, with their apex reflexed in bud. Carpels (5–)7–9, glabrous to sparsely shortly hirsute, mainly in the apical part, *ca* 9 by 2½ mm, with *ca* 15 mm long styles. Cell-wall inside the apical part and wall of the stylar canal hirsute. Each carpel with 9–11 ovules. *Fruit* dehiscent, the sepals enlarged to *ca* 28 by 20 mm. Carpels 18 by 16 mm, showing the hirsuteness inside the apical part. Seeds unknown.

**Distr. Malaysia:** Philippines (Luzon).

**Ecol.** In forests at low altitude.

**Uses.** The wood is used for building purposes.

**Vern.** *Babacao* (Ibanag dial.), *malacatmon* (Tag.), *marapalali* (Ilocane).

**Notes.** The leaves of the species are similar to those of *D. luzoniensis* and *D. monantha*; the species is easily distinguished by the winged petiole and consequently amplexicaul leaf-scar.

## 22. *Dillenia bolsteri* MERR. Philip. J. Sc. Bot. 7 (1912) 305; En. Philip. 3 (1923) 59.—*Dillenia cauliflora* MERR. Philip. J. Sc. Bot. 9 (1915) 517; En. Philip. 3 (1923) 60.

Tree, up to 20 m high. *Leaves* elliptic-oblong, *ca* 15–29-nerved, 10–25 by 4–11 cm, with acuminate apex with *ca* 1 cm long acumens, acute to obtuse

base, and slightly dentate margin, most strongly so in the upper part of the leaf. Petiole 2–4½ cm long, with lanceolate, 4–6 mm broad wings; wings villose-pubescent beneath, caducous. Inflorescence either a terminal, 2–4-flowered, up to 10 cm long raceme, or cauline with a woody, sparingly branched axis with flowers solitary or in 2-flowered racemes terminal on this sympodially built axis. Cauline inflorescence with ovate bracts, representing the winged petiole of the normally developed leaf, conduplicate, *ca* 10–20 mm long, 2 × 5–10 mm broad, amplexicaul, leaving amplexicaul scars on the axis. *Flowers* *ca* 6 cm diam. Sepals 5, elliptic, *ca* 20 by 16 mm. Petals whitish, 30 by 13 mm. Stamens in 2 distinct groups, the outer ones *ca* 160, 5–5½ mm long, straight in bud, the inner ones *ca* 25, 7–8½ mm long, with their apex reflexed in bud. Carpels 8–10, *ca* 6 by 3 mm with cylindrical, 7 mm long styles, each with 6–8 ovules. *Fruit* indehiscent, globular, *ca* 2½ cm diam. including the enclosing sepals, which are up to 30 by 30 mm, at the base 0.4 mm thick. Carpels *ca* 15 by 9 mm, 1-seeded. Seeds obovate, 5 by 3½ mm, exarillate.

**Distr. Malaysia:** Philippines (Samar, Leyte, and Surigao Prov. of Mindanao).

**Ecol.** In primary forests at low altitude.

**Notes.** The present species is the only one in *Dillenia* where these sympodially built cauline inflorescences are found. The twig-born and cauline inflorescences of *Dillenia pentagyna* and related species most probably are monopodial and comparable with the inflorescences of *Dillenia pulchella*.

## 23. *Dillenia auriculata* MARTELLI in BECC. Malesia 3 (1886) 159.—*Wormia auriculata* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35; A. C. SMITH, J. Arn. Arb. 22 (1941) 501.

Slender, tall tree, up to 30 m high, with flaky reddish brown bark. *Leaves* oblong, *ca* 8–12-nerved, 7–16 by 3–7 cm, with rounded-obtuse to acute apex, rounded to obtuse base, and entire to slightly undulate margin, glabrous. Petiole 1½–5 cm long, with up to 7 mm broad, linear-lanceolate wings; wings caducous except often a small, up to 5 mm long, upper part, remaining as 2 small auricles below the blade. Raceme 1–3-flowered, up to 11 cm long. *Flowers* *ca* 8–10 cm diam. Sepals 5, the outer 2 *ca* 17–19 by 15–17 mm, the inner 3 *ca* 25–30 by 20–24 mm. Petals narrowly obovate, yellow, *ca* 40 by 16 mm. Stamens in 2 distinct groups, the outer ones *ca* 225, 8–10 mm long, straight in bud, the inner ones *ca* 28, *ca* 18 mm long, with their apex reflexed in bud; yellow. Carpels 6–10, *ca* 8 by 3 mm, with linear, red, 16 mm long styles; each with 8–11 ovules. *Fruit* unknown.

**Distr. Malaysia:** New Guinea.

**Ecol.** On riversides and in ridge forests. *Ca* 1 m long propoots are noted for this species.

## 24. *Dillenia castaneifolia* (MIQ.) MARTELLI ex DUR. & JACKS. Ind. Kew. Suppl. 1 (1902) 136 (*castaneaefolia*); DIELS, Bot. Jahrb. 57 (1922) 438.—*Wormia castaneifolia* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 78; MARTELLI in BECC. Malesia



3 (1886) 164 (*castaneaefolia*); MIQ. *ex* HOOK. f. & JACKS. Ind. Kew. 2 (1895) 1233 (*castaneaefolia*).—*Wormia macdonaldi* F.V.M. Vict. Natural. 2 (1886) 146; Bot. Centralbl. 26 (1886) 114.—*Dillenia misorensis* MARTELLI in BECC. Malesia 3 (1886) 160.—*Dillenia albertisiana* MARTELLI in BECC. Malesia 3 (1886) 161.—*Wormia longepetiolata* WARB. Bot. Jahrb. 13 (1891) 378.—*Dillenia pedunculata* K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 445.—*Dillenia macdonaldi* MARTELLI *ex* DUR. & JACKS. Ind. Kew. Suppl. 1 (1902) 136.—*Wormia hirta* RIDL. Trans. Linn. Soc. Bot. 9 (1916) 13.—*Dillenia longepetiolata* DIELS, Bot. Jahrb. 57 (1922) 436.—*Dillenia hirta* DIELS, Bot. Jahrb. 57 (1922) 436.—*Dillenia castaneifolia* var. *dolichobotrys* DIELS, Bot. Jahrb. 57 (1922) 439.—*Wormia misorensis* GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 35.—*Dillenia alata* var. *macrophylla* (non LAUT.) LANE POOLE, Rep. For. Res. Papua (1925) 116.

Tree, up to 20 m high, 50 cm diam., with light brown heartwood. *Leaves* oblong to elliptic-oblong, *ca* 10–16-nerved, 10–25 by 5–15 cm, with acute to rounded apex and base and entire to slightly dentate margin. Petiole  $1\frac{1}{2}$ –6 cm long, with 4–7 mm broad wings; wings narrowing towards the base of the blade, caducous. Raceme 1–6-flowered, up to 30 cm long. *Flowers*  $6\frac{1}{2}$ –9 cm diam. Sepals 5, the outer 2 elliptic to circular, 15 by 12–15 mm, the inner 3 obovate, 20–30 by 15–18 mm. Petals deep lemon yellow, 40–50 by 25–30 mm. Stamens in 2 distinct groups, the outer ones *ca* 250–300,  $6\frac{1}{2}$ –8 mm long, straight in bud, the inner ones *ca* 23–35, 11–14 mm long, with their apex reflexed in bud; on the outside often a number of staminodes (up to 25). Carpels 8–10, red, 6–7 by  $1\frac{1}{2}$ –2 mm, with 9–11 mm long styles, each with *ca* 6–12 ovules. *Fruit* dehiscent, when ripe with carmine red sepals enlarged to 30–40 by 17–20 mm. Carpels 15 by 10 mm, 1-seeded. Seeds 4 by  $3\frac{1}{2}$  mm, enclosed by a membranaceous aril.

*Distr. Malaysia:* New Guinea and islands in the Geelvink Bay.

*Ecol.* In primary and secondary forests, usually on riversides.

*Vern. Oesang, wesang* (Dutch New Guinea).

*Notes.* The species is very variable in size of the leaves, less so in the leaf-shape, and in the length of the inflorescence. These forms, described as separate species or varieties, are connected with each other by intermediate forms, and considered here to represent one, polymorphic species, the most polymorphic one found in the genus.

**25. *Dillenia eximia*** MIQ. Fl. Ind. Bat. Suppl. (1860) 620; Ann. Mus. Bot. Lugd. Bat. 4 (1868) 79; MERR. En. Born. (1921) 383.—*Dillenia crassiseptala* MARTELLI in BECC. Malesia 3 (1886) 156; MERR. En. Born. (1921) 383.—*Wormia scortechinii* KING, J. As. Soc. Beng. 58, 2 (1889) 365.—*Wormia kunstleri* KING, J. As. Soc. Beng. 58, 2 (1889) 366.—*Dillenia scortechinii* RIDL. J. Str. Br. R. A. S. 54 (1910) 7; Fl. Mal. Pen. 1 (1922) 12.

Deciduous tree, up to 40 m high, 70 cm diam., with large buttresses, passing into stilt-roots.

*Leaves* elliptic to obovate, *ca* 18–28-nerved, 15–25 by 9–15 cm, with rounded to obtuse apex, obtuse to somewhat cordate base, and entire to undulate-dentate margin; in saplings longer and narrower, 45–80-nerved, 35–75 by 13–25 cm. Petiole 3–7 cm long, in saplings up to 17 cm. Inflorescence a (3–) 5–12(–18)-flowered composed raceme, forming a loose cluster. *Flowers* appearing with the leaves, apetalous, *ca*  $2\frac{1}{2}$  cm diam. Sepals 5, about circular, 9–12 mm diam. Stamens all of approximately the same length, *ca* 150–180,  $4\frac{1}{2}$ – $5\frac{1}{2}$  mm long; margin of the anthercells ciliate. Carpels 4–6, usually 5, white, *ca*  $3\frac{1}{2}$  by  $1\frac{1}{2}$  mm, with 5 mm long, white styles, each with *ca* 30 ovules. *Fruit* indehiscent, dark green, slightly flattened-globular, *ca* 30 mm diam., 25 mm high including the enclosing sepals, which are up to 40 by 27 mm, at the basis up to 8 mm thick. Carpels 10 by 7 mm, 1–2-seeded. Seeds  $5\frac{1}{2}$  by  $3\frac{1}{2}$  mm, with a rudimentary, about 0.2 mm long aril.

*Distr. Malaysia:* Sumatra, Malay Peninsula, and Borneo.

*Ecol.* In primary forests at low altitude (to 300 m), on wet to rather dry soil. *Fl.* in the Mal. Pen. from March to May, *fr.* from April to July; in Sumatra and Borneo *fl.* from July to Nov., *fr.* from Nov. to Jan.

*Uses.* The wood is rarely used in house-building.

*Vern. Mal. Pen.: simpoh, s. jangkang* (=stilted s.), *merah*. Sumatra: *bawal* (Djambi), *bira* (Indr.) *djangkang* (Pal.), *gawal, gawar* (Indr.), *mempelu* (Sum. E. Coast), *sédjérangkong* (Pal.), *simar timbaho darat* (Tapan.), *simpur, s. kidjang, s. rawang* (Pal.). Borneo: *bériga, riga* (Daj.), *djongong* (Mal.), *entepung rimba* (Mal.), *ketang bajut* (Daj.), *kadiang* (Mal.), *markadjang* (Daj.), *suretang* (Daj.), *těmpuru* (Daj.).

**26. *Dillenia borneensis*** HOOGL. *spec. nov.*

Tree, probably deciduous, up to 40 m high, 70 cm diam., with stilt-roots. *Leaves* elliptic to elliptic-oblong or obovate, *ca* 25–35-nerved, 25–40 by 12–20 cm, with rounded apex, obtuse base, and minutely undulate-dentate margin. Petiole 4–9 cm long, densely sericeously hirsute above. Inflorescence a 3–10-flowered composed raceme, forming a loose cluster. *Flowers* appearing with the leaves, *ca* 6 cm diam. Sepals 5, elliptic, 1.2–2 by 0.8–1.4 cm. Petals yellow, *ca*  $2\frac{1}{2}$  by  $1\frac{1}{2}$  cm. Stamens *ca* 335, in 2 distinct groups, either the outer group all of the same length, *ca* 8 mm long, straight in bud, the inner group *ca* 14 mm long, with their apex reflexed in bud, or the stamens of the outer group gradually decreasing in size towards the centre from 11 to 4 mm, with their apex more or less inflexed in bud, those of the inner group *ca* 13 mm long, with their apical part (*ca* 2 mm) reflexed. Carpels 7–8, *ca* 8 by 1 mm, with *ca* 8 mm long styles, each with *ca* 25–50 ovules. *Fruit* unknown.

*Distr. Malaysia:* Borneo.

*Ecol.* In primary and secondary forest at low altitude.

*Vern. Gèrige, riga, rogung* (Daj.), *simpur* (Mal.).

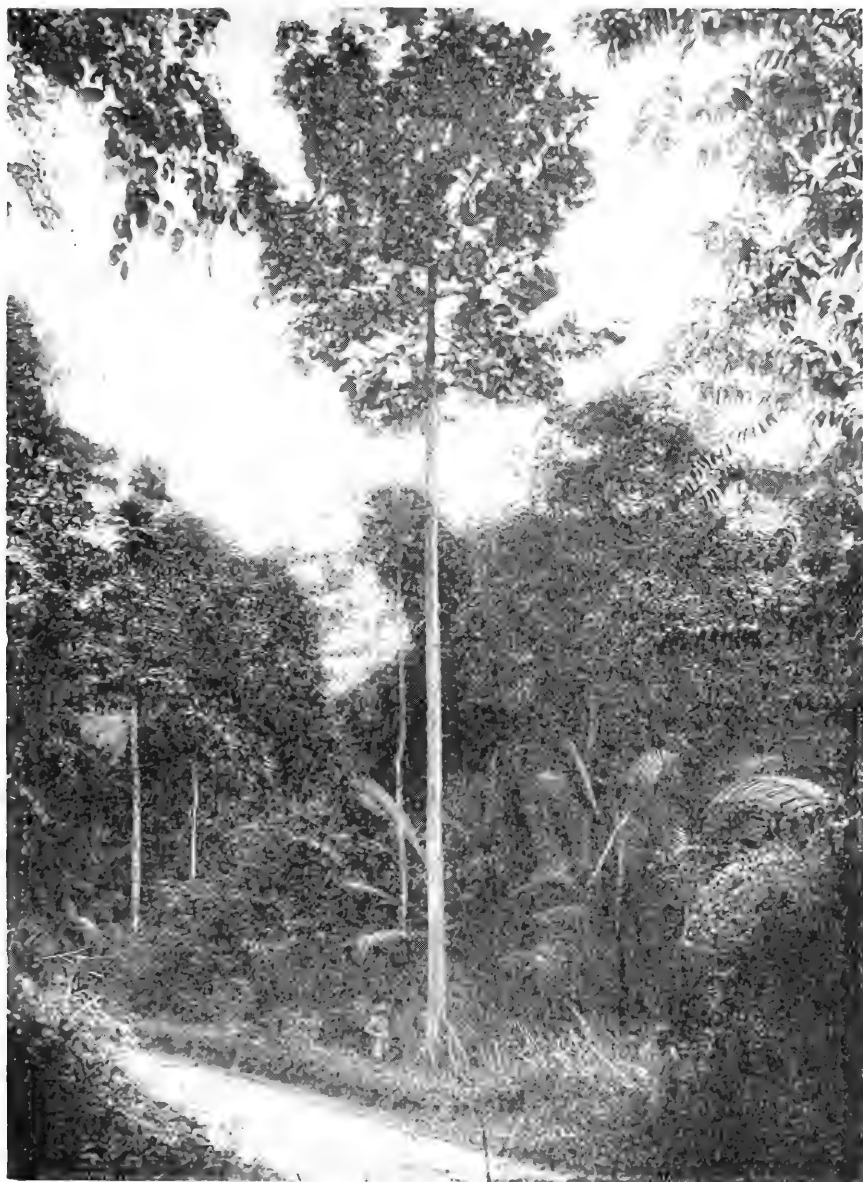


Fig. 11. *Dillenia reticulata* KING with stilt-roots in the Mal. Peninsula. Courtesy For. Res. Institute, Kepong.



Notes. Most specimens have the second type of androecium; the first type was found only in one collection, which agrees with the species in all other characters. As, however, the flowers in this specimen (JAHERI 840) are not attached to the specimen, but added loose, I have not given this form varietal rank, though I am convinced that the flowers belong to the specimen. When better known, the two forms may have to be distinguished as separate varieties. The species is strongly characterized by the densely hirsute upper side of the petiole.

**27. *Dillenia reticulata*** KING, J. As. Soc. Beng. 58, 2 (1889) 367; RIDL. Fl. Mal. Pen. 1 (1922) 11; FOXW. Mal. For. Rec. 3 (1927) 148 (with 2 plates); BURK. Dict. (1935) 810.—*Wormia mollissima* BOERL. Cat. Hort. Bog. (1899) 5.—?*Dillenia rhizophora* BOERL. & KOORD. in KOORD.—SCHUM. Syst. Verz. 2 (1910) 36.—Fig. 11.

Deciduous tree, up to 40 m high, 17 cm diam., with conspicuous stilt-roots. *Leaves* elliptic or elliptic-oblong to obovate, *ca* 25–35-nerved, 15–30 by 10–20 cm, with rounded to slightly emarginate apex, obtuse to rounded or cordate base, and entire to slightly undulate-dentate margin. Petiole 4–10 cm long. Inflorescence a (3–)5–10(–15)-flowered composed raceme, forming a loose cluster. *Flowers* appearing with the leaves, *ca* 8 cm diam. Sepals 5, broadly elliptic, *ca* 20–25 by 16–20 mm. Petals yellow, *ca* 35 by 16 mm. Stamens *ca* 400–440, all straight in bud, those of the outer whorl *ca* 11 mm long, those immediately within this whorl 5 mm long, the size gradually increasing towards the centre of the flower to 9 mm in the innermost ones. Carpels 9–10, *ca* 6 by 1½ mm, with 5–6 mm long styles, each with 50–70 ovules. *Fruit* indehiscent, greenish yellow, slightly flattened-globular, *ca* 35 mm diam, 30 mm high including the enclosing sepals, which are up to 45 by 42 mm, at the base 6 mm thick. Carpels 16 by 8½ mm, 1–3-seeded. Seeds 3½ by 2½ mm, with a rudimentary, *ca* 0.2 mm long aril.

Distr. *Malaysia*: Sumatra, Malay Peninsula, and Borneo.

Ecol. In primary forests at low altitude, on wet to rather dry soil. The stilt-roots are also developed when the tree grows in a never-flooded habitat. As far as can be derived from the few collections, the flowering- and fruiting-time agree with those of *Dillenia eximia* MIQ.

Vern. Mal. Pen.: *simpoh*, *s. jangkang* (=stilted s.), *s. paya* (=marsh s.). Borneo: *simpur*, *témpuran*.

Notes. In the vegetative state the species is not distinguishable with certainty from hirsute forms of *Dillenia eximia* MIQ. *Dillenia rhizophora* BOERL. & KOORD. is such a status, most probably referable to the present species.

On account of the hairiness of the carpels two varieties can be distinguished: *var. reticulata* with the carpels hirsute in the apical part, and *var. psilocarpella* HOOGL. *var. nov.* with glabrous carpels. The first variety is known only from the Malay Peninsula, the second from the whole area of the species.

**28. *Dillenia hookeri*** PIERRE, Fl. For. Coch. 1 (1879) t. 5; FIN. & GAGNEP. Fl. Gén. I.C. 1 (1907) 20; CRAIB, Fl. Siam. En. 1 (1925) 22.

Tree, 10–15 m high, or, more often, low shrub, 1½–2 m high, with reddish wood. *Leaves* oblong to oblanceolate, *ca* 30–40-nerved, 17–22 by 7–9 cm, with rounded, sometimes slightly acuminate apex, acute base, and entire to slightly dentate margin, densely velvety-tomentose beneath. Petiole 1½–4 cm long. *Flowers* single, rarely 2, terminal, 4–5 cm diam., the pedicel with 3 verticillate bracteoles; bracteoles lanceolate, 20–35 by 7–10 mm. Sepals 5–6, ovate to elliptic, *ca* 15 by 10 mm, densely silky hairy outside. Petals yellow, *ca* 25 by 13 mm. Stamens *ca* 200, all of approximately the same length, 8–10 mm long, with sharply emarginate apex. Carpels 6–7, *ca* 5 by 1½ mm with 11 mm long styles, each with *ca* 18 ovules. *Fruit* indehiscent, 2–2½ cm diam. including the enclosing sepals, which are up to 25 by 14 mm. Carpels 14 by 6 mm, 1–5-seeded. Seeds obovate, 3½ by 3 mm, exarillate.

Distr. Indo-China and Siam, N. to *ca* 17° N, in *Malaysia*: only in Peninsular Siam.

Ecol. In open deciduous forests and savannahs.

Notes. PIERRE l.c. describes and figures the stamens as being of different lengths, arranged in 2 groups. I analysed several flowers, but always found all stamens of approximately the same length. This species is the only Malaysian one, which combines this character with a not amplexicaul leaf-basis.

**29. *Dillenia luzoniensis*** (VIDAL) MARTELLI ex DUR. & JACKS. Ind. Kew. Suppl. 1 (1902) 136; MERR. Philip. J. Sc. 1 (1906) Suppl. 95; En. Philip. 3 (1923) 60.—*Wormia luzoniensis* VIDAL, Rev. Pl. Vasc. Filip. (1886) 36; ELMER, Leaflet. Philip. Bot. 7 (1915) 2622.—*Tetracera borneensis* (non MIQ.) VIDAL, Rev. Pl. Vasc. Filip. (1886) 36.

Small tree, *ca* 5 m high. *Leaves* subcoriaceous, elliptic to oblong, *ca* 6–12-nerved, 6–15 by 3–7 cm, with rounded to slightly emarginate apex, rounded base, and entire to slightly undulate margin, glossy. Petiole ½–1 cm long. Raceme terminal, later lateral, leaf-opposed, with only one flower at the same time, up to 40 cm long with 30 scars of fallen flowers; axis more or less zig-zag. *Flowers* 6–8 cm diam. Sepals 5, elliptic, 15–18 by 10–14 mm. Petals yellow, 4–5 by 3–4 cm. Stamens in 2 distinct groups, the outer ones *ca* 120, 8 mm long, straight in bud, the inner ones *ca* 50, 14–20 mm long, with their apex reflexed in bud; on the outside often a few staminodes, 7 mm long. Carpels 7–8, *ca* 8 by 2½ mm, with 10 mm long styles, each with *ca* 16 ovules. *Fruit* dehiscent, the sepals pink, enlarged to *ca* 25 by 15 mm. Carpels 17 by 14 mm, 1–2-seeded. Seeds ovoid, 3 by 2 mm, enclosed by a membranaceous, up to 5 mm long aril.

Distr. In *Malaysia*: Philippines (Palawan, Luzon).

Ecol. On riverbanks in forests at low altitude.

Notes. As MERRILL (1923) included under the species a number of specimens of *Dillenia diantha* HOOGL. his data on vernacular names and altitudinal distribution are not reliable. He gives as the altitudinal limit 1200 m.

30. *Dillenia excelsa* (JACK) GILG in ENGL. & PR. Nat. Pl. Fam. 3, 6 (1893) 123; MERR. En. Born. (1921) 383; En. Philip. 3 (1923) 60; HEYNE, Nutt. Pl. (1927) 1072.—*Wormia excelsa* JACK, Mal. Misc. 2, 7 (1822) 69; DE VRIESE, Pl. Ind. Bat. Or. (1856) 79, t. 6-7; MIQ. Fl. Ind. Bat. 1, 2 (1859) 10; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 76; KOORD. & VAL. Bijdr. 1 Booms. Java (1894) 168; MOLL & JANS. Mikr. Holz. Jav. Baumart. 1 (1906) 71; BACK. Schoolfl. Java (1911) 10; KOORD. Exk. Fl. Java 2 (1912) 600; KOORD. & VAL. Atl. Baumarten Java 1 (1913) f. 4; GAGE & BURK. J. Str. Br. R. A. S. 73 (1916) 243; CORN. Gard. Bull. S. S. 10 (1939) 5; Wayside Trees Malaya (1940) 206; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 80, p. 3.—*Capellia multiflora* BL. Bijdr. 1 (1825) 5.—*Capellenia multiflora* BL. ex HASSK. Cat. Hort. Bog. alt. (1844) 178.—*Capellenia pauciflora* ZOLL. & MOR. Syst. Verz. (1845-6) 35.—*Wormia oblonga* WALL. Cat. (1828) no 951, nomen; Hk. f. & Th. Fl. Ind. 1 (1855) 67; MIQ. Fl. Ind. Bat. 1, 2 (1859) 11; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 35; KING, J. As. Soc. Beng. 58, 2 (1889) 364; RIDL. Fl. Mal. Pen. 1 (1922) 9.—*Wormia grandifolia* MIQ. Fl. Ind. Bat. Suppl. (1860) 619.—*Wormia excelsa* f. *grandifolia* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 76.—*Wormia excelsa* var. *borneensis* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 77.—*Dillenia magnoliaefolia* MARTELLI in BECC. Malesia 3 (1886) 155.—*Dillenia glabra* MARTELLI in BECC. Malesia 3 (1886) 157; MERR. En. Born. (1921) 383.—*Dillenia tomentella* MARTELLI in BECC. Malesia 3 (1886) 159; MERR. En. Born. (1921) 383.—*Dillenia mattanensis* MARTELLI in BECC. Malesia 3 (1886) 160; MERR. En. Born. (1921) 383.—*Dillenia oblonga* GILG in ENGL. & PR. Nat. Pl. Fam. 3, 6 (1893) 123.—*Dillenia pauciflora* GILG in ENGL. & PR. Nat. Pl. Fam. 3, 6 (1893) 123.—*Wormia pauciflora* KOORD. & VAL. Bijdr. 1 Booms. Java (1894) 169; BACK. Schoolfl. Java (1911) 10.—*Capellia pauciflora* ZOLL. & MOR. ex HOOK. f. & JACKS. Ind. Kew. 1 (1895) 415.—*Wormia tomentella* RIDL. J. Str. Br. R. A. S. 33 (1900) 37; J. Str. Br. R. A. S. 54 (1910) 5; Fl. Mal. Pen. 1 (1922) 9; BURK. Dict. (1935) 2265.—*Dillenia secunda* HUNTER (ed. by RIDL.) J. Str. Br. R. A. S. 53 (1909) 98.—*Dillenia excelsa* var. *borneensis* MERR. En. Born. (1921) 383.—*Wormia excelsa* var. *pubescens* CORN. Gard. Bull. S. S. 10 (1939) 7.—*Wormia excelsa* var. *tomentella* CORN. Gard. Bull. S. S. 10 (1939) 8.—*Dillenia excelsa* var. *pubescens* CORN. ex MASAMUNE, En. Phan. Born. (1942) 463.—*Dillenia excelsa* var. *tomentella* CORN. ex MASAMUNE, En. Phan. Born. (1942) 463.

Tree, up to 40 m high with 20 m clean trunk, 75 cm diam., with gray to brown bark, scurfy with reddish scales, and red to dark brown heartwood. Leaves coriaceous, elliptic to oblong, ca 10-13-nerved, 15-30 by 7-10 cm, with rounded to acute, sometimes slightly acuminate apex, acute, often unequal-sided base, and slightly undulate, entire or dentate margin, glossy. Petiole 2-5 cm long. Raceme simple or composed, the only lateral branch at the place of the second flower, up to 12-flowered, sometimes some inflorescences crowd-

ed at the end of a branch and inflorescence therefore seemingly up to 30-flowered. Flower 7-10 cm diam., the pedicel distinctly thickened at the apex. Sepals 5, elliptic to ovate, 20-25 by 13-16 mm, glabrous to rather densely tomentose outside. Petals bright yellow, 40-50 by 25-33 mm. Stamens in 2 distinct groups, the outer ones ca 300, 10-11 mm long, straight in bud, the inner ones ca 30, 16-20 mm long, with their apex reflexed in bud. Carpels 5-10, usually 6-8, 12-14 by 2½ mm, with 16-20 mm long, pink styles, each with 20-25 ovules. Fruit dehiscent. Carpels 18-20 by 12-16 mm, yellowish green outside, whitish inside, 1-3-seeded. Seeds 6 by 4 mm, dark brown, with a 2-3 mm long, red, membranaceous aril.

Distr. Malaysia: Sumatra, Malay Peninsula, Banka, W. Java (E. to Nusa Kambangan), Borneo, and Philippines (Balabac Island, S of Palawan).

Ecol. In forests on rather dry to swampy soil, often along streams.

Uses. The wood, which has a durability indoors of 15-20 years, is sometimes used in housebuilding.

Vern. A large number of vernaculars has been noted: Sumatra: *ampalu*, *a. rimbo* (Tapan., Sum. W. Coast), *bahah falah* (Simalur), *boengah-simpur* (= flower-s.) (Indrag.), *enehè* (Enggano), *kalek bakoerok* (Tapan., Sum. W. Coast), *nilau birrih* (Djambi), *peileggoo* (Mentawai), *pisang mawe* (Sum. E. Coast), *simpur* (Djambi, Sum. E. Coast, Palemb., Benk.), *s. arèng* (Lamp.), *s. ayer* (Lamp.), *s. kimbe* (Palemb.), *s. lakki* (Banka), *s. pèrampuan* (Lamp.), *s. rawang* (Lamp., Palemb.), *s. rimba* (Benk., Banka, Palemb.), *s. talang* (Palemb.), *s. tjipuh* (Sum. E. Coast), *s. way* (Lamp.), *s. sisitoeë* (Atjeh). Malay Peninsula: *kambai hutan*, *penaga hlui*, *simpur*, *s. ayer*, *s. padi*, *s. pagar*, *s. pasir*, *s. paya*. Java: *djadjatian* (Sund.), *drègèl* (Jav.), *ki sègèl*, *sègèl*, *sèmpur sègèl*, *s. tjai* (Sund.), *s. batu*, *s. lanang* (Jav.), *simpur* (Mal.), *wuru* (Jav.). Borneo: *alang-alung* (Daj., Punan), *djamihing* (Mal., Bondarese), *djelangin* (Tidung, Batajan), *djengin* (Mal., Berauw.), *djing*, *djochin* (Daj.), *gara* (Daj., Kapuas), *kadjamihing* (Daj., Kapuas; Mal., Sampit), *kajuringin* (Daj.), *kandikara* (*këndikara*, *kandikara*) (Mal., Kutinese), *kanigara* (*kënegara*, *kali-gara*) (Bandjar., Bondar., Mal.), *këgihing*, *urib* (Daj.), *pampam* (Dusun rungun), *randaman* (Banggi), *ringin* (Daj., Dusun), *simpurotan* (Mal., Br. N. Borneo), *simpur* (Mal., Br. N. Borneo), *s. bukit* (Mal., Sarawak), *s. laki* (Mal., Brunei, Sarawak and Sandakan), *tidahura*, *tjumihiing* (Daj., Siangese). In the Bahasa Indonesia *këndikara* has been accepted.

Notes. CORNER (1939, l.c.) distinguishes 2 varieties besides the typical form. *Dillenia excelsa* var. *pubescens* (CORN.) CORN. ex MASAMUNE is distinguished by the tomentose-hirsute indumentum on the outer side of the sepals, continuing on the pedicel and the axis of the inflorescence. This is the commonest form of the species in the Malay Peninsula and is also found in Sumatra, Borneo, and the Philippines. In Borneo intermediates to the typical form with glabrous sepals are frequent. *Dillenia excelsa* var. *tomentella* (MARTELLI) CORN. ex MASAMUNE is distinguished by the hirsute indu-

mentum on the intervenium on the lower side of the leaf; it is found in Sumatra, the Malay Peninsula, Banka, and Borneo.

The species is rather variable, but is easily recognised by the rather large, coriaceous, lucid leaves, and the typically thickened apex of the pedicel, which occurs in most species, but is in none so pronounced.

**31. *Dillenia sibuyanensis* (ELM.) MERR.** Philip. J. Sc. Bot. 9 (1914) 332; En. Philip. 3 (1923) 62.—*Wormia sibuyanensis* ELM. Leaf. Philip. Bot. 5 (1913) 1772.

Shrub, 3 m high or higher, with smooth bark, scaling off in plates. *Leaves* rigidly chartaceous, narrowly obovate to oblanceolate, *ca* 7–9-nerved,  $3\frac{1}{2}$ –7 by 1.1–2½ cm, with acuminate apex, acute base, decurrent along the petiole, and entire to slightly undulate margin; glossy above. Petiole 1–1½ cm long. *Flowers* solitary or, rarely, in a 2–3-flowered raceme, *ca* 5 cm diam. Sepals 7–9, elliptic to obovate, the outer ones *ca* 12 by 7 mm, the inner ones *ca* 15 by 10 mm. Petals lemon yellow, *ca* 3 by 1.3 cm. Stamens in 2 distinct groups, the outer ones *ca* 70, 7–8 mm long, straight in bud, the inner ones *ca* 20, 12–16 mm long, with their apex reflexed in bud. Carpels 5–8, usually 7, bright red, *ca* 6–8 by 1½–1.8 mm, with 12 mm long, white styles, each with 6 ovules. *Fruit* dehiscent. Carpels 15 by 10 mm, 1-seeded. Seeds obovate,  $3\frac{1}{2}$  by 2.8 mm, enclosed by a yellow, membranaceous aril.

Distr. *Malaysia*: Philippines (Sibuyan Isl.).

Ecol. Scattered along forested river banks from about sea level to 300 m.

**32. *Dillenia ovata* WALL.** Cat. (1828) no 945, *nomen*; Hk. f. & Th. Fl. Ind. 1 (1855) 70; Miq. Fl. Ind. Bat. 1, 2 (1859) 12; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 36; PIERRE, Fl. For. Coch. 1 (1879) t. 10; KING, J. As. Soc. Beng. 58, 2 (1889) 366; BACK, Fl. Batavia 1 (1907) 5; BACK, Schoolfl. (1911) 11; KOORD. Exk. Fl. Java 2 (1912) 601; RIDL, Fl. Mal. Pen. 1 (1922) 11; BURK. Dict. (1935) 810; CORN. Wayside Trees Malaya (1940) 204; BACK, Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 5.

Tree, up to 30 m high and 1 m diam. but usually smaller, 6–12 m high and 30–40 cm diam., with rather knotted trunk and low-attached crown. *Leaves* ovate or elliptic, *ca* 18–25-nerved, 10–25 by 7–13 cm, on saplings *ca* 50-nerved, 30–60 by 14–18 cm, with rounded to obtuse, on saplings acute apex, rounded to acute, often unequal-sided base, and entire to obscurely dentate margin. Petiole *ca* 2½–5 cm long. Underside of the leaf and petiole hirsute-tomentose. *Flower* *ca* 16 cm diam. Sepals 5, elliptic, 25–30 by 16–27 mm, the innermost ones the narrowest, the two outer ones densely villose outside, the third one with one glabrous margin, the inner ones densely villose on the central part only. Petals yellow,  $6\frac{1}{2}$ –7½ by 5–6 cm. Stamens in 2 distinct groups, the outer ones, *ca* 450, 16–20 mm long, straight in bud, the inner ones, *ca* 25, 25 mm long, with their apex reflexed in bud. Carpels 8–12, usually 10, 6–7 by 2–2½ mm, with 20 mm long, yellowish white styles; each with *ca*

50 ovules. *Fruit* indehiscent, dull yellow, depressed-globose, *ca* 4½ cm high, 6 cm diam. including the enclosing sepals, which are *ca* 7½ by 5½ cm, at the base 1½ cm thick. Carpels *ca* 22 by 10 mm, each with 1–7 seeds in glutinous pulp. Seeds obovoid, 5 by 4 mm, black, glabrous, exarillate.

Distr. Siam and Indo-China to *ca* 17° 30' N, in *Malaysia*: Sumatra, Malay Peninsula (except Malacca and Johore), Banka. In Java cultivated only.

Ecol. On sandy or rather dry spots, in belukar, at low alt.

Uses. The wood is used in Indo-China for making small objects.

Vern. *Simpoh ajer* (Mal. Pen.), *simpur laki* (*lalaki*) (Banka) (= male s.), *s. minjak*, *ranggang wakka* (S. Sum.).

**33. *Dillenia sumatrana* MIQ.** Fl. Ind. Bat. Suppl. (1860) 620.—*Dillenia meliosmaefolia* Hk. f. & Th. Fl. Br. Ind. 1 (1875) 36; RIDL, J. Str. Br. R. A. S. 54 (1910) 7; Fl. Mal. Pen. 1 (1922) 12; HEYNE, Nutt. Pl. (1927) 1072; BURK. Dict. (1935) 810; CORN. Gard. Bull. S. S. 10 (1939) 3; Wayside Trees Malaya (1940) 204.—*Wormia meliosmaefolia* KING, J. As. Soc. Beng. 58, 2 (1889) 365; ANN. Roy. Bot. Gard. Calc. 5 (1896) 115, t. 130.—*Wormia parviflora* RIDL, J. Str. Br. R. A. S. 54 (1910) 6; Fl. Mal. Pen. 1 (1922) 9.—*Dillenia elmeri* MERR. Pl. Elm. Born. (1929) 195.

Tree, up to 20 m high, 35 cm diam., with reddish brown bark. *Leaves* oblong, *ca* 15–20-nerved, 16–30 by 7–16 cm, with acute to acuminate apex, acute to obtuse base, and nearly entire to manifestly dentate margin. Petiole 1½–5 cm long. *Flowers* solitary or in a 2(–3)-flowered raceme with the flowers attached close to each other, *ca* 6 cm diam. Sepals 5, ovate, 10–14 by 9–11 mm, densely silky hirsute outside. Petals yellow, *ca* 25 by 15 mm. Stamens in 2 distinct groups, the outer ones *ca* 200, 6–7½ mm long, straight in bud, the inner ones *ca* 18–20, 10–11 mm long, with their apex reflexed in bud. Carpels 7–10, white, *ca* 4–5 by 1½ mm, with white, 5–6 mm long styles, each with 15–20 ovules. *Fruit* indehiscent, yellow or orange-yellow, about globular, 2–2½ cm diam. including the enclosing sepals, which are up to 35 by 20 mm, up to 2½ mm thick at the base. Carpels *ca* 12 by 7 mm, 1–2-seeded. Seeds 5 by 3½ mm, exarillate.

Distr. *Malaysia*: Sumatra (incl. Nias and Siberut Islands), Malay Peninsula (W.-side only), and Borneo (Sarawak and Br. N. Borneo).

Ecol. In forests at low altitude to *ca* 350 m.

Uses. The wood is sometimes used in house-building.

Vern. Malay Peninsula: *simpur*, *s. bukit*, and *s. padi*. Sumatra: *sipang-sipang* and *duwa saopang* (Sum. E. Coast), *wahom bouho* (Nias), *surumak dëlök* (Simalaru).

**34. *Dillenia monantha* MERR.** Philip. J. Sc. Bot. 9 (1914) 321; En. Philip. 3 (1923) 60.

Smooth-barked tree, up to 17 m high. *Leaves* subcoriaceous, elliptic-oblong to lanceolate, *ca* 7–9-nerved, 8–14 by 3½–7 cm, with rounded to obtuse, rarely acute apex, obtuse to acute base, and slightly

undulate-dentate margin, glossy. Petiole 5–25 mm long. *Flowers* solitary, terminal, *ca* 10 cm diam. Sepals 5, 15–22 by 12–15 mm. Petals yellow, *ca* 50 by 28 mm. Stamens *ca* 110, the outer ones from 9 mm long, straight in bud, the inner ones up to 15 mm long, with their apex reflexed in bud, with intermediate lengths. Carpels 4–5, *ca* 7–8 by 1½ mm, glabrous to sparsely hirsute with 0.2–0.4 mm long, rather rigid hairs, each with 11–16 ovules. Styles 8 mm. *Fruit* dehiscent, carpels *ca* 15 by 13 mm.

Distr. *Malaysia*: Philippines (from Palawan to Busuanga).

Ecol. In dry secondary forests and in open grasslands at low altitudes.

Vern. *Malacatmon* (Palawan).

**35. *Dillenia indica* LINNÉ, Sp. Pl. (1753) 535; BURM. f. Fl. Ind. (1768) 124; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 79; HK. f. & TH. Fl. Br. Ind. 1 (1872) 36; KING, J. As. Soc. Beng. 58, 2 (1889) 366; KOORD. & VAL. Bijdr. 1 Booms. Java (1894) 161; GAMBLE, Man. Ind. Timb. 2nd ed. (1902) 4; MOLL & JANS. Mikr. Holz. Jav. Baumart. 1 (1906) 71; BACK. Schoolfl. Java (1911) 10; KOORD. Exk. Fl. Java 2 (1912) 601; KOORD. & VAL. Atl. Baumart. Java 1 (1913) f. 2; MERR. En. Born. (1921) 383; TROUP, Sylvicult. Ind. Trees 1 (1921) 3; WESTER, Philip. Agr. Rev. 14 (1921) 277; RIDL. Fl. Mal. Pen. 1 (1922) 10; GILG & WERDERM. in ENGL. & PR. Nat. Pfl. Fam. ed. 2, 21 (1925) 34, f. 25; HEYNE, Nutt. Pl. (1927) 1072; BURK. Dict. (1935) 809; BLATTER & MILLARD, J. Bomb. Nat. Hist. Soc. 38 (1936) 415, pl. 29, 31 & 32; Some Beautiful Ind. Trees (1937) 45 and 3 pl.; CORN. Wayside Trees Malaya (1940) 204, pl. 52; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 4.—*Syalita* RHEEDE, Hort. Mal. 3 (1683) 39, t. 38–39; ADANS. Fam. Pl. 2 (1763) 364.—*Dillenia speciosa* THUNB. Trans. Linn. Soc. 1 (1791) 200; SM. Exot. Bot. 1 (1804) 3, t. 2, 3; ROXB. Fl. Ind. ed. CAREY 2 (1832) 650; HK. f. & TH. Fl. Ind. 1 (1855) 69; MIQ. Fl. Ind. Bat. 1, 2 (1859) 11.—*Dillenia elongata* MIQ. Fl. Ind. Bat. 1, 2 (1859) 12.—*Dillenia indica* f. *elongata* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 79.**

Tree, up to 30 m high, 120 cm diam., with rather crooked trunk and irregular, usually rather lowly (up to 15 m) attached crown. *Leaves* bright green above, oblong, *ca* 25–50-nerved, 10–35 by 5–13 cm, on saplings and young trees up to 70 by 18 cm, with acute to acuminate apex, rounded to acute base, and slightly to manifestly dentate margin. Petiole 2½–7½ cm long, on saplings and young trees up to 15 cm. *Flower* 15–20 cm diam. Sepals 5, elliptic, 4–6 by 3–5 cm, up to 1 cm thick at the base. Petals white, 7–9 by 5–6½ cm. Stamens in 2 distinct groups, the outer ones, *ca* 550, 13–15 mm long, straight in bud, the inner ones, *ca* 25, 20–22 mm long, with their apex reflexed in bud; yellow. Carpels 14–20, *ca* 14 by 3 mm, yellowish green, with linear-lanceolate, white, 25 mm long, up to 3½ mm broad styles; each with 40–80 ovules. *Fruit* indehiscent, yellowish green, 8–10 cm diam. including the enclosing sepals, which are up to 15 by 12 cm, 2½ cm thick at the base. Carpels *ca* 35

by 15 mm, each with 5 or more seeds in colourless glutinous pulp. Seeds reniform, 4 by 6 mm, black, finely echinate, exarillate.

Distr. Ceylon, India (Deccan Peninsula, Bengal, Assam), S. China (Yunnan), Burma, Siam, Indo-China, in *Malaysia*: Sumatra, Malay Peninsula, W. and M. Java, Borneo.

Ecol. Mainly on stony banks of rivulets (Saraca-streams, CORNER) and rivers, mainly at low elevation up to 500 m. Once collected at 1700 m (Atjeh, Sumatra).

Uses. The fruit, in particular the enclosing sepals, is eaten fresh and in curries and jellies. With syrup a cough mixture is made from it. The wood, which is moderately hard and has a durability under water of *ca* 3 years, is sometimes used for house-building or gunstocks (India). The species is planted rather often as an ornamental tree.

Vern. The Malay name, in use in Sumatra, the Malay Peninsula and Java is *simpur* or *s. ayer* (= water s.). In Sundanese the name is *sempur*, *s. batoe* (= stone s.) or *s. tjai* (= water s.), in Javanese *sempoe* or *kosar*. In the Philippines, where the species is cultivated, it is known under the Singalese name *hondapara*. Engl.: *elephant-apple*.

Notes. The dispersal of the seeds is said to be effected by animals, among others by elephants (BLATTER & MILLARD), or with current water. In the latter case the seeds may germinate in the fruit, which is left behind on the bank of a river, often partly filled up with mud, which gives a favorable substratum for the germination.

**36. *Dillenia pulchella* (JACK) GILG in ENGL. & PR. Nat. Pfl. Fam. 3, 6 (1893) 123; MERR. En. Born. (1921) 383; HEYNE, Nutt. Pl. (1927) 1072.—*Wormia pulchella* JACK, Mal. Misc. 2, 7 (1822) 70; HK. f. & TH. Fl. Ind. 1 (1855) 68; MIQ. Fl. Ind. Bat. 1, 2 (1859) 11; HK. f. & TH. Fl. Br. Ind. 1 (1872) 36; KING, J. As. Soc. Beng. 58, 2 (1889) 365; GAGE & BURK. J. Str. Br. R.A.S. 73 (1916) 243; RIDL. Fl. Mal. Pen. 1 (1922) 9; BURK. Dict. (1935) 2265; CORNER, Wayside Trees Malaya (1940) 206.—*Dillenia micrantha* MARTELLI in BECC. Malesia 3 (1886) 156; MERR. En. Born. (1921) 383.—*Dillenia parvifolia* MARTELLI in BECC. Malesia 3 (1886) 158; MERR. En. Born. (1921) 383.**

Tree, up to 40 m high with 25 m clean trunk, 90 cm diam., with reddish bark. *Leaves* elliptic to obovate, 4–8-, usually 6–7-nerved, *ca* 5–12 by 3½–6½ cm, with rounded, sometimes slightly emarginate, to obtuse apex, acute base, decurrent along the petiole, and entire margin. Petiole 1–1½ cm long. *Flowers* axillary, solitary or 2(–3) serially placed, less often 3–6 on the apical part of a branch in the axil of distinct leaf-scars. *Flowers* *ca* 3½ cm diam., on 2½–7½ cm long pedicels. Sepals 5; ovate to elliptic, the outer one *ca* 8½ by 7 mm, the inner four 12–16 by 8–11 mm. Petals yellow, about oblong, 20 by 9 mm. Stamens in 2 distinct groups, the outer ones *ca* 110, 4–4½ mm long, straight in bud, the inner ones *ca* 10, 10–11 mm long, distinctly thicker than those of the outer group, with their apex reflexed in bud; opening with lateral longitudinal slits. Carpels 4–6, usually 5, *ca* 4–4½

by 1-1½ mm, with 5½-6½ mm long styles; each with 7-10 ovules. *Fruit* dehiscent. Carpels ca 15 by 12 mm, 1-2-seeded. Seeds obovate, 3 by 2 mm, enclosed by a red, membranaceous aril.

*Distr. Malaysia:* Sumatra (not in the Lampung Distr.), Malay Peninsula, Riouw- and Lingga Archipelagos, Banka, and Borneo (only W. Borneo, Sarawak, and Br. N. Borneo).

*Ecol.* In primary or old secondary lowland forests, on wet, often peaty soil. Seems to be flowering at irregular intervals.

*Uses.* The wood, which is hard and heavy, is of good quality and is used in house-building.

*Vern.* Sumatra: *djaha keling* (Pal.), *dungun* (Sum. E. Coast), *simar pimasa* (Tapan.), *simpur paja* (Sum. E. Coast), *Mal. Pen.:* *simpur ayer* (= water s.), *s. paya* (= marsh s.), *s. paya hitam* (= black marsh s.). Riouw-Arch.: *pêrêpat darat*. Borneo: *debak lulus, ilas* (Daj.), *simpur bukit, s. laki, s. paya, s. rimba* (Brunei and Br. N. Borneo).

*Notes.* The present species is the only one in *Dillenia* with axillary flowers. Probably the inflorescences of a group of cauli- and ramiflorous species, of which *Dillenia pentagyna* Roxb. is the only Malaysian representative, are comparable to the 3-6-flowered leafless branches, which sometimes occur in the present species, in which the axis is reduced.

**37. *Dillenia pentagyna* ROXB.** Pl. Corom. 1 (1795) 21, t. 20; Fl. Ind. ed. CAREY 2 (1832) 652; Hk. f. & Th. Fl. Ind. 1 (1855) 71; Miq. Fl. Ind. Bat. 1, 2 (1859) 12; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 38; KURZ, For. Fl. Br. Burma 1 (1877) 21; PIERRE, Fl. For. Coch. 1 (1879) pl. 6-8; KOORD. & VAL. Bijdr. 1 Booms. Java (1894) 163; FIN. & GAGNEP. Fl. Gén. I.C. 1 (1907) 19; BACK. Schoolfl. Java (1911) 11; KOORD. Exk. Fl. Java 2 (1912) 601; KOORD. & VAL. Atl. Baumart. Java 1 (1913) f. 3; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 5.—*Colbertia coromandeliana* DC. Syst. 1 (1818) 435.—*Wormia coromandelina* SPRENG. Syst. 2 (1825) 631.—*Colbertia augusta* WALL. Cat. (1828) no 948, *nomen*; G. DON, Gen. Syst. 1 (1831) 77 (*Wormia augusta* STEUD. Nomencl. ed. 2, 2, 1821, 789, *nomen*).—*Dillenia augusta* ROXB. Hort. Beng. (1814) 43, *nomen*; Fl. Ind. ed CAREY 2 (1832) 652.—*Colbertia minor* ZOLL. & MOR. Nat. Gen. Arch. N.I. 2 (1845) 579.—*Dillenia floribunda* Hk. f. & Th. Fl. Ind. 1 (1855) 71; Hk. f. & Th. Fl. Br. Ind. 1 (1872) 38 (*Wormia floribunda* STEUD. Nom. ed. 2, 2, 1821, 789, *nomen*); *Colbertia floribunda* WALL. Cat., 1828, no 950, *nomen*).—*Dillenia pentagyna* var. *augusta* KURZ, J. As. Soc. Beng. 43, 2 (1874) 46.—*Dillenia bailonii* PIERRE ex LANESS. Pl. Util. Colon. Fr. (1886) 281, 702; FIN. & GAGNEP. Fl. Gén. I.C. 1 (1907) 19.—*Dillenia minor* GILG in ENGL. & PR. Nat. Pfl. Fam. 3, 6 (1893) 125.—*Dillenia hainanensis* MERR. Lingn. Sc. J. 13 (1934) 64.

Deciduous tree, up to 25 m high, with usually rather crooked, up to 12 m high clear trunk, to 1 m diam. Bark smooth, grayish, peeling off in thin scales. *Leaves* elliptic-obovate, ca 25-50-nerved, 20-50 by 10-20 cm, with rounded to obtuse

apex, acute base, decurrent along the petiole, and manifestly dentate to nearly entire margin. Petiole 1½-5 cm long, slightly winged with permanent, not amplexicaul wings. Leaves on saplings and young plants oblanceolate, up to 75-nerved, up to 120 by 40 cm, with up to 15 mm broad petiolar wings, not sharply separated from the blade, distinctly nerved like the blade. *Flowers* 2-7 in a fascicle on an up to 3 mm long, short shoot with hairy bracts, on branches of 6 mm and more diam.; flowering mainly when leafless. *Flowers* 2½-3 cm diam., on a 2½-6 cm long pedicel without bracteoles. Sepals 5, elliptic, 8-12 by 5-9 mm. Petals yellowish or whitish, 15-20 by 5-10 mm. Stamens in 2 distinct groups, the outer ones 60-90, 2½-4 mm long, straight in bud, the inner ones 10, 6-9 mm long, with their apex reflexed in bud, opening with longitudinal slits. Carpels 5(-6), ca 3½-4 by 1.2-1.5 mm, with 4 mm long styles; each with 5-20 ovules. *Fruit* indehiscent, approximately globular, yellow, orange or red, 15 mm diam., 13 mm high including the enlarged, fleshy sepals, which are up to 16 by 14 mm, up to 3 mm thick at the base. Carpels ca 8 by 5 mm, 1(-2)-seeded. Seeds ovoid, 5 by 3½ mm, exarillate.

*Distr.* In monsoon-regions, in continental Asia: India (Deccan Peninsula, N. to United Prov. and Assam), Burma, Andamans, Siam, Yunnan, Indo-China, and Hainan, in *Malaysia:* M. and E. Java (W to Cheribon), Kangean, S. Celebes (Makassar and Muna Isl.), and Lesser Sunda Islands (Timor, Sumba, and Wetar) (cf. fig. 12).

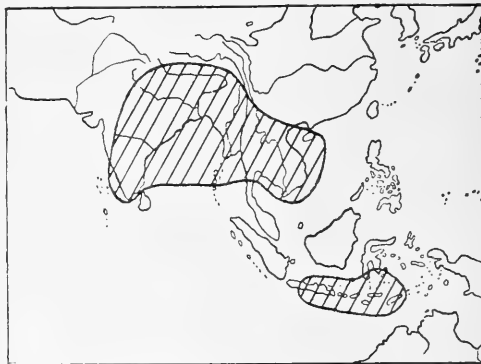


Fig. 12. Geographical distribution of *Dillenia pentagyna* ROXB. (disjunct shaded areas).

*Ecol.* In primary and teak forests, also in fire-savannahs, up to 1000 m alt., on periodically often very dry localities. Seems to be rather fire-resistant. Fl. June-November, at one locality all trees approximately at the same time.

*Uses.* The wood, though of rather good quality, is rarely used because of its crookedness; a rather good charcoal is made of it.

*Vern.* *Djunti* (Sund.), *sẽmpu* (Jav.) and *sumpor* (Mad., also in Kangean) in Java, *rondomi* in Muna, *kahalalô* and *papunuk* in Wetar.

*Notes.* The species is the only Malaysian representative of a small group of deciduous trees



Fig. 13. *Dillenia obovata* (BL.) HOOGL. G. Pantjar, West Java (DE VOOGD).

with fascicled flowers; the other species are found only in the monsoon-regions of continental Asia.

**38. *Dillenia obovata* (BL.) HOOGL. comb. nov.**—*Colbertia obovata* BL. Bijdr. 1 (1825) 6; HASSK. Pl. Jav. Rar. (1848) 175.—*Wormia obovata* SPRENG. Cur. Post. (1827) 213.—*Dillenia ornata* WALL. Pl. As. Rar. 1 (1830) 21, t. 23; PARKINSON, Ind. Forster 61 (1935) 451, pl. 28, f. 1.—*Dillenia aurea* (non SM.) HK. f. & TH. Fl. Ind. 1 (1855) 70, p.p.; DE VRIESE, Pl. Ind. Bat. Or. (1856) 80; MIQ. Fl. Ind. Bat. 1, 2 (1859) 12; Ann. Mus. Bot. Lugd. Bat. 4 (1868) 80; HK. f. & TH. Fl. Br. Ind. 1 (1872) 37, p.p.; PIERRE, Fl. For. Coch. 1 (1879) pl. 11–13; KING, J. As. Soc. Beng. 58, 2 (1889) 367; KOORD. & VAL. Bijdr. 1 Booms. Java (1894) 165; FIN. & GAGNEP. Fl. Gén. I.C. 1 (1907) 21; BACK. Fl. Batavia 1 (1907) 21, 385; Schoofl. Java (1911) 11; KOORD. Exk. Fl. Java 2 (1912) 601; KOORD. & VAL. Atl. Baumart. Java 1 (1913) f. 1; RIDL. Fl.

Mal. Pen. 1 (1922) 11; HEYNE, Nutt. Pl. (1927) 1071; BURK. Dict. (1935) 809, p.p.; CORN. Wayside Trees Malaya (1940) 201, pl. 50, 51; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 80, 5.—*Dillenia harmandii* GAGNEP. Not. Syst. 6 (1937) 39.—**Fig. 13.**

Deciduous tree, with rather crooked trunk, up to 35 m high with up to 14 m clear trunk, to 70 cm diam. *Leaves* obovate, dull with a waxy coating beneath, ca 30–45-nerved, 20–40 by 12–20 cm, with rounded, on young plants and saplings acute, apex, acute, gradually narrowing base, and entire to slightly dentate margin. Petiole  $1\frac{1}{2}$ –4 cm long. *Flowers* solitary, rarely 2 or 3, at the end of short side-branches, near the basis of the peduncle with a number of bracts, flowering mainly before the appearance of the leaves. *Flowers* 14–16 cm diam. Sepals 5, elliptic, ca 30–38 by 20–30 mm. Petals bright yellow,  $6\frac{1}{2}$ –8 by  $4\frac{1}{2}$ –5 $\frac{1}{2}$  cm. Stamens in 2 distinct groups, the outer ones yellow, ca 200–240, 12–13 mm long, straight in bud, the inner ones

yellowish white, *ca* 40–55, 22–24 mm long, with their apex reflexed in bud. Carpels *ca* 9–11, *ca* 13 by 2 mm, with 20 mm long styles, each with 25–35 ovules. *Fruit* indehiscent, yellow or orange-coloured, approximately globular, 35–40 mm diam. including the enlarged fleshy sepals, which are up to 50 by 40 mm, 6 mm thick at the base. Carpels *ca* 25 by 10 mm, 1- to few-seeded. Seeds 5 by 3½ mm, exarillate, embedded in transparent slime.

Distr. Lower Burma, Indo-China, and Siam, in *Malaysia*: Northern part of the Malay Peninsula, S. Sumatra, and W. Java.

Ecol. In secondary forests, on stony, period-

ically rather dry soils. *Fl.* at the end of the relatively dry period, about April in the Malay Peninsula, July to October in S. Sumatra and W. Java.

Uses. The fruit is eaten in curries, the wood sometimes used in house-building.

Vern. Mal. Pen.: *simpur*. Sumatra: *simpur*, *s. bĕnĕr*, *s. rimba*, *s. talang*. Java: *sĕmpu* (Jav.), *sĕmpur*, *s. batu* (Sund.).

Notes. *Dillenia aurea* SM. is a closely related species, occurring in NE. India and N. and Central Burma; cf. PARKINSON (1935). The differences in reproductive parts are slight, but the leaf-shape in adult state is very characteristic.

#### Excluded and doubtful

*Dillenia grandifolia* WALL. Cat. (1828) no 946, *nomen*; HK. f. & TH. Fl. Ind. 1 (1855) 71; MIQ. Fl. Ind. Bat. 1, 2 (1859) 12; HK. f. & TH. Fl. Br. Ind. 1 (1872) 38; KING, J. As. Soc. Beng. 58, 2 (1889) 368; RIDL, J. Str. Br. R. A. S. 59 (1911) 61; Fl. Mal. Pen. 1 (1922) 11; CRAIB, Fl. Siam. En. 1 (1925) 22; CORN. Wayside Trees Malaya (1940) 203.

The type-collection consists of leaves from a young tree or sapling and is referable either to *Dillenia ovata* WALL. ex HK. f. & TH. or to *Dillenia reticulata* KING. Most of the later literature refers to specimens belonging to the latter species. From study of the leaves of saplings of both species, which come into consideration, the identity must be decided.

*Dillenia indica* var. *aurea* (SM.) O.K. Rev. Gen. Pl. 1 (1891) 4.

KUNTZE, when making this new combination, had a specimen of *Dillenia ovata* WALL. ex HK. f. & TH., from cultivation in the Botanic Gardens at Bogor. *Dillenia aurea* SM. is an Indian species; cf. *sub D. obovata* (BL.) HOOGL.

*Tetracera tripetala* TURCZ. Bull. Soc. Nat. Mosc. 36, 1 (1863) 547.

The description is insufficient for identification. Of the Javanese species *Tetracera sagifolia* BL. comes nearest to it; most probably the species will have to be reduced to it.



## CAPRIFOLIACEAE (J. H. Kern, Bogor, and C. G. G. J. van Steenis, Leyden)

Small trees, shrubs or twining woody plants, rarely herbs; branches terete. Glands present in various parts. Indumentum consisting of simple hairs, or in *Viburnum* sometimes lepidote; glandular hairs mostly present. Stems often pithy. *Leaves* decussate, simple or deeply divided (*Sambucus*), sometimes provided with pitted or cup-shaped glands exuding resin. Stipules absent or very small. *Flowers* ♀, actinomorphic or zygomorphic, mostly cymosely arranged, 4-5-merous; outer flowers in an inflorescence sometimes differing from the normal ones, rarely (*Sambucus p.p.*) some fls aborted into extra-floral nectaries. *Calyx* adnate to the ovary, (4-5)-fid or -toothed, mostly constricted below the limb; sepals often enlarged in fruit. *Corolla* epigynous, gamopetalous, sometimes 2-lipped, lobes mostly imbricate in bud. Stamens inserted on the corolla tube, alternating with the lobes, extrorse or introrse. Anthers free, 2-celled, dorsifixed, versatile, cells parallel, opening lengthwise, mostly introrse; filaments sometimes reflexed or curved in bud. Ovary inferior, 1-(2-3)-5-(8)-celled, in fruit cells sometimes partly abortive. Style terminal, often slender with one knoblike stigma, or 3 short partly connate styles. Ovules 1(-∞), pendulous or axile. *Fruit* a drupe or berry, rarely a capsule. Seeds often only one per fruit, often with bony testa. Endosperm copious, sometimes ruminant; embryo straight, often small and linear, axial, cotyledons oval or oblong.

Distr. Ca 10-14 genera, mainly distributed on the N. hemisphere, in the tropics mostly confined to the mountains, on the S. hemisphere only *Viburnum* and *Sambucus*, an endemic genus in New Zealand, two monotypic endemic genera in New Caledonia, in Australia only *Sambucus* in the eastern part.

Ecol. *Caprifoliaceae* do not play an important role in Malaysian vegetation as to numbers: both *Lonicera* and some *spp.* of *Sambucus* may predominate locally in mountain thickets and clearings. Most members of the family are insect-pollinated; *Lonicera* has a nocturnal fragrance; the exact function of the peculiar metamorphosed flowers in *Sambucus javanica* is not known.

Uses. Many *spp.* of all three genera treated here are used as ornamentals. The honey-suckles (*Lonicera*) have mostly fragrant flowers.

Notes. The family seems to be most related to the *Valerianaceae* to which the foliage of *Sambucus* and the occurrence of valerianic acid in *Viburnum* add in importance, but there is no unanimity on the delimitation of the family.

BAILLON (Hist. Pl. 7, 1880, 352 seq.), MCATEE (Bull. Torrey Bot. Club 48, 1921, 149), and FRITSCH (Bot. Centr. Bl. 1892, ii, p. 169) are of opinion that *Caprifoliaceae* ought to be merged into *Rubiaceae*. The occurrence of interpetiolar stipules or appendages accepted to represent stipules obscure a clear distinction. I fail to understand why KURZ can eliminate *Scyphiphora* from the *Rubiaceae* and refer it to *Caprifoliaceae* (J. As. Soc. Beng. 45, ii, 1876, 133; For. Fl. 2, 1877, 4) 'by the structure of the ovary and position of the ovules which are tell-tale marks of its caprifoliaceous descent', as the gynoecium is very variable in *Rubiaceae*. Moreover, *Scyphiphora* possesses stipules bearing colleters (see below).

With *Carlemannia* and *Sylvianthus* (the latter absent from Malaysia) the case is different; HOOKER f. and PITARD included them in *Rubiaceae*. SOLEREDER in his valuable study on the anatomy of the rubiaceaceous complex showed (Bull. Herb. Boiss. 1, 1893, 171, 173, 174) that they belong to *Caprifoliaceae*, by absence of stipules and presence of capitate-glandular hairs typical of *Caprifoliaceae*. He is followed by HALLIER f. and BREMEKAMP.

However, a general merging of *Caprifoliaceae* into *Rubiaceae* seems to us undesirable, as by that procedure the various caprifoliaceous genera would be assigned to various rubiaceaceous tribes, and come to remote positions not reflecting their affinity.

Another question is whether, contrarily, genera hitherto accepted as rubiaceaceous ought to be removed to *Caprifoliaceae*. SOLEREDER (l.c.), followed by KRAUSE (Ber. D.B.G. 28, 1909, 446-452) and GLÜCK (Blatt- u. Blütenmorph. Stud. 1919, 135) have focussed attention to the regular and typical occurrence of resin-glandular bodies, or trichomes, on the adaxial basis of Rubiaceaceous stipules, called colleters. Colleters are known in a limited number of other families and genera such as *Cunoniaceae*, *Rhizophoraceae*, *Caesalpinaceae*, and, as was found recently, are also typical for *Nothofagus*. Dr BAKHUIZEN VAN DEN BRINK Jr, who is now revising *Rubiaceae* for this Flora, has found them in all genera hitherto studied except a few, viz: *Dentella*, *Hedyotis*, *Borreria*, *Spermacoce*, *Richardsonia*, *Anotis*, *Allaeophania*, and *Diodia*, of which genera some appear to be aberrant in *Rubiaceae* on account of their ovules, by which character they come now wide apart in rubiaceaceous taxonomy, whereas in other points they appear



closely allied (cf. also BOERLAGE, Handl. 2, 1891, 9, 10 & 19). The research on the problem whether these are really rubiaceous is one of time-consuming nature and of too great importance to be solved prematurely. Pending continued research the present revision is published in the old circumscription of *Caprifoliaceae*. It seems desirable to make additional karyological investigations on genera eventually to be joined to *Caprifoliaceae* as in the old circumscription the basic chromosome numbers seem to be rather constantly 8 and 9 (cf. SAX & KRIBS, J. Arn. Arb. 11, 1930, 147–152). An account of pollen structure seems also desirable.

The genus *Gaertnera* is distinct from *Rubiaceae* by a superior ovary and absence of colletes, and will be treated, in this Flora, as loganiaceous, though SOLEREDER (Ber. D.B.G. Gen.-Vers. Heft 1890, p. 70; Bull. Herb. Boiss. 1, 1893, 169) assigns it to *Rubiaceae*. In both families it keeps an isolated position.

The family appears to us a coherent and natural one: minor though by no means neglectable characters common to all are: glandular hairs and glands in other parts, enlarging sepals, a distinct constriction between ovary and sepals, and dorsifixed anthers, a character hitherto not specially stressed in literature (in *Sambucus* the cells are free but fixed in the middle!).

Leaves of juvenile forms of some species are occasionally distinctly lobed, e.g. in *Symphoricarpos* and *Lonicera*.

In collecting *Caprifoliaceae* it is urgent to collect both full-grown flowers and ripe fruits.

The first author is responsible for the revision of *Viburnum*, the second author for the rest.

#### KEY TO THE GENERA

- |   |                       |
|---|-----------------------|
| 1. Leaves pinnate . . . . .   | 3. <i>Sambucus</i>    |
| 1. Leaves simple.   |                       |
| 2. Erect herbs. Corolla 4-merous. Stamens 2. Capsule dehiscent . . . . .  | 4. <i>Carlemannia</i> |
| 2. Shrubs, small trees, or lianas. Corolla 5-merous. Stamens 5. Drupe or berry.   |                       |
| 3. Ovary-cells with more than 1 ovule. Corolla 2-lipped, at least 12 mm long. Style simple, long, with a capitate stigma. Berry . . . . . | 1. <i>Lonicera</i>    |
| 3. Ovary-cells with one ovule. Flowers actinomorphic, at most 10 mm long. Style 3-fid, short. Drupe.                                      | 2. <i>Viburnum</i>    |

#### 1. LONICERA

LINNÉ, Sp.Pl. (1753) 173; Gen. Pl. (1754) no 210; DC. Prod. 4 (1830) 330; REHDER, Rep. Mo. Bot. Gard. 14 (1903) 27–232, pl. 1–20; STEEN. J. Arn. Arb. 27 (1946) 443.—*Caprifolium* ZINN. Cat. Pl. Gött. (1757) 10.

Shrubs or (in *Malaysia* exclusively) woody climbers twining to the right, or, in the absence of sufficient support, locally scrambling shrubs; bark at last lengthwise splitting, twigs mostly contorted. Leaves hairy or glabrous, entire (in the *Malaysian spp.*), free (or in *extra-Malaysian subg. Periclymenum*) connate. Stipules absent, but leaf-bases connected by a raised line on the node. *Flowers* 5-merous, mostly sessile, in 2-flowered, axillary, peduncled or rarely almost sessile cymes, not rarely specially developed towards the end of the branches and forming a leafy terminal panicle. Cymes occasionally 3-flowered. Each pair of flowers subtended by 2 bracts and 4 bracteoles, the latter sometimes covering the ovary. Calyx-tube ovoid or subglobose, teeth mostly small. Corolla elongated, mostly 2-lipped, upper lip representing 4 lobes, and mostly 4-lobed at its apex, lobes imbricate in bud. Stamens 5, anthers introrse, mostly exserted; filaments inserted near the apex of the tube. Ovary 2–3-celled, style filiform, elongated, usually exsert, and exceeding the stamens, stigma capitate. Ovules axile, 3–8 per cell, pendulous. *Berries* mostly few-seeded, free or (in *extra-Malaysian spp.*) connate in pairs. Seeds generally ovoid with fleshy albumen and a terete embryo.

Distr. *Ca* 150 *spp.* described from the N. hemisphere, centering in the Himalayas to Central and E. Asia, not in Ceylon, crossing the equator only in *Malaysia*.

The *Malaysian spp.* belong to § *Nintooa* DC. comprising  $\pm$  30 *spp.* centering in SE.–E. Asia, with 1 *sp.* in the Mediterranean.

Ecol. In *Malaysia* only found in the W. part, confined to the zones above 1000 m alt.

Uses. Two *spp.* are used widely as ornamentals.

Wood anat. CHALK & SCHATTAWAY, Proc. Roy. Soc. B 113 (1933) 82.

Notes. In the absence of sufficient support specimens may turn to scrambling, but they are in the forest true lianas.

For measurements of flowers, full-grown open flowers should be used. All Malaysian *spp.* including the cultivated ones belong to § *Nintooa*.

In my eye REHDER has distinguished too many *spp.* in this section. His subsections *Longiflorae* and *Breviflorae* I think are rather artificial.

## KEY TO THE SPECIES

1. Bracts below each pair of flowers foliaceous . . . . . 1. *L. japonica*
1. Bracts subulate to lanceolate, not leafy.
2. Ovary hairy all over . . . . . 2. *L. confusa*
2. At most the extreme apex of the ovary hairy.
3. Flowers in the dried state at most  $\pm 2\frac{1}{2}$  cm long.
4. Flowers slender, 2–4 on slender axillary peduncles. Flowering parts hairy and besides with capitate glandular hairs. In anthesis both lips recurved. Internodes slender, twigs soon shiny-brown. 7. *L. javanica*
4. Flowers thickish, crowded towards the twig-ends, peduncles short, congested towards the twig-ends, flowers not exceeding the leaves. Capitate glandular hairs absent or negligible. In anthesis only the lower lip recurved. Internodes stiffish, twigs not shiny-brown . . . . . 6. *L. acuminata*
3. Opened flowers in the dried state at least 3 cm long.
5. Plant entirely glabrous (except few negligible hairs on stamens and style and some ciliae on bracts and calyx). Nerves few, not prominent, reticulations indistinct . . . . . 3. *L. sumatrana*
5. Plants hairy, nerves and reticulations distinct.
6. Inflorescences many-flowered, mostly congested into a globose or oval leafy panicle. Floral parts with subsessile, capitate, glandular hairs. Leaves glaucous-tomentose underneath, nerves and reticulations impressed above . . . . . 5. *L. pulcherrima*
6. Peduncles axillary, 2-flowered. Capitate glandular hairs absent. Nerves and reticulations hirsute underneath, not distinctly impressed above . . . . . 4. *L. malayana*

1. *Lonicera japonica* THUNB. Fl. Jap. (1784) 89; MIQ. Ann. Mus. L.B. 2 (1866) 269; REHDER, Ann. Mo. Bot. Gard. 14 (1903) 159; BOR & RAIZADA, J. Bombay N. H. Soc. 44 (1943) 76, f. 3; STEEN. J. Arn. Arb. 27 (1946) 444, *in clavis*; BACKER, Bekn. Fl. Java, em. ed. 8 (1949) fam. 175, p. 6.—*Lonicera chinensis* WATSON, Dendr. Brit. 2 (1825) t. 117; HASSK. Flora 28 (1845) 242; FILET, Pl. Bot. Tuin Weltevreden (1855) 60; MIQ. Fl. Ind. Bat. 2 (1856) 127; KURZ, Nat. Tijd. N.I. 27 (1861) 198.—*L. repens* ZIPP. ex HASSK. Cat. Hort. Bog. (1844) 116, *in syn.*; MIQ. Fl. Ind. Bat. 2 (1856) 128; STEEN. L.c. 451; Blumea 6 (1948) 243.

Twining. Twigs short-pubescent, glabrescent, sparsely glandular-hairy, shiny-brown, ultimate internodes short-tomentose. Leaves ovate-oblong to ovate-lanceolate, base rounded to truncate, apex acute, acutish or subacuminate, midrib and edges pilose, darkgreen and shiny above;  $3-8\frac{1}{2}$  by  $1\frac{1}{2}-4$  cm, petiole  $\frac{3}{4}-1$  cm. Flowers fragrant, 3–5 cm. Peduncle  $\frac{1}{4}-1\frac{1}{2}$  cm, tomentose. Bracts petioled, leafy, oblong-ovate, or oblong-obovate, 10–18 by 4–8 mm. Bracteoles roundish,  $\frac{3}{4}$  mm, hairy, glandular, ciliate. Calyx-lobes linear from a triangular base, haired,  $\pm 1\frac{1}{2}$  mm, ciliate. Corolla 4–5 cm, creamy, or pale rosa-tinged towards the base, fading orange-yellow, lobes as long as the tube, hairs mixed with capitate glandular hairs, tube  $\pm 2\frac{1}{2}$  cm, lobes  $\frac{1}{3}$  of the limb of upper lip. Style glabrous,  $\pm$  as long as the corolla. Stamens glabrous. Berry globular, 6–7 mm diam., black.

Distr. From Yunnan to Formosa & Japan, in *Malaysia*: cultivated as an ornamental up to  $\pm 1000$  m.

Ecol. Fruit is rarely set in *Malaysia*, fl. Jan.–Dec.

Uses. BURKILL (Dict. 1935, 1363) says that at Singapore Chinese import flowers from China; they are said to possess antifebrile, corrective and

astringent properties. The vegetative parts contain a saponin.

Notes. An early introduction, possibly via the Botanic Gardens at Bogor, as far as known never run wild. Many varieties have been distinguished (REHDER, l.c.).

2. *Lonicera confusa* DC. Prod. 4 (1830) 333; REHDER, Ann. Mo. Bot. Gard. 14 (1903) 156; MERR. En. BOTN. (1921) 582; BOR & RAIZADA, J. Bomb. N.H. Soc. 44 (1943) 75, f. 2; STEEN. J. Arn. Arb. 27 (1946) 444 *in clavis*; BACKER, Bekn. Fl. Java, em. ed. 8 (1949) fam. 175, p. 6.—*L. japonica* (non THUNB.) ANDR. Bot. Rep. 9 (1809) t. 583.—*L. multiflora* CHAMP. in HOOK. J. Bot. Kew Misc. 4 (1852) 167.

Whole plant short-tomentose, with the exception of the upperside of the leaves which is sparsely pubescent. Twigs  $\pm$  eglandular. Leaves ovate-oblong to oblong, base rounded, truncate, or subcordate, apex acute or acutish, margin tending to recurve, texture tending to be bullate by impressed nerves and reticulations, 3–6 by  $1\frac{1}{2}-3$  cm. Petiole  $\frac{1}{2}-1\frac{1}{4}$  cm. Inflorescences lateral, condensed,  $\pm 7$ -flowered or at the end of twig multiflorous, provided with reduced leaves, exceeding the leaves, on 1–2 cm long stalks; cymes  $\pm$  sessile or some mm peduncled. Bracts linear, as long as or longer than the ovary, rarely subspathulate. Bracteoles suborbicular, 1 mm, hairy. Calyx-lobes narrow-triangular, hirsute, shorter than the ovary. Corolla 4–5 cm, pubescent, lobes  $\pm$  as long as the slender tube, provided with capitate glandular hairs; apex of the upper lip split for  $\frac{1}{5}$  of its length, lobes ovate. Style glabrous. Stamens only slightly hairy towards the base.

Distr. China, Hainan, in *Malaysia* rarely cultivated as an ornamental.

Note. Closely allied to *L. japonica*, in one specimen I found subspathulate bracts tending to become foliaceous.

**3. *Lonicera sumatrana*** MIQ. Fl. Ind. Bat. Suppl. (1860) 213, 537; REHDER, Rep. Mo. Bot. Gard. 14 (1903) 149; STEEN, J. Arn. Arb. 27 (1946) 445.—*L. leiantha* KURZ, J. As. Soc. Beng. 43, II (1874) 188; For. Fl. Burma 2 (1877) 3; REHDER, *l.c.* 163; CRAIB, Fl. Siam. En. 2 (1932) 5.—*Caprifolium sumatranum* O.K. Rev. Gen. 1 (1891) 274.—*L. leianthum* O.K. *l.c.*—*L. jasminifolia* MERR. Pap. Michigan Ac. Sc. 19 (1934) 199.

Slender, ± entirely glabrous. Internodes 4–7 cm. Leaves subtriplinerved at the base, without distinct reticulations, thickish, narrowed towards the base, elliptic to oblong-elliptic, acuminate, 4–9 by 2–3 cm, nerves 4–5 on either side, not prominent; petiole  $\frac{1}{3}$ –1 cm long. Peduncles axillary and terminal, 1–1½ cm long, 2-flowered; at the twig-ends sometimes 4 ± together. Flowers slender, glabrous except some small negligible ciliae on the edge of the calyx and bracts, white or rosa-like beige. Bracts half as long as the ovary, lanceolate-acuminate, 1½–2 mm. Bracteoles suborbicular-ovate, 1 mm, blunt. Calyx-tube (ovary) constricted at the apex, free part shorter than the ovary, split halfway down, lobes ovate, subacute, 1 mm. Corolla slender, 5½–6½ cm long; tube 3½–4 cm, upper lip split into 4 lobes ±  $\frac{1}{5}$ – $\frac{1}{6}$  of its length. Style subglabrous with reflexed, sparse, white hairs, 6–7 cm long. Stamens subglabrous, distinctly exsert.

Distr. S. Siam (Puket), Ava (Burma), Yunnan, in *Malaysia*: Sumatra (rare).

Ecol. Thickets and forest borders in the mountain regions, 1000–1250 m, fl. Apr.–June.

Vern. *Kaju kaleh simienjak* (Alahanpandjang).

Notes. REHDER places this well-defined *sp.* incorrectly in *subsect. Breviflorae* because of the fact that MIQUEL described the flowers after specimens in the immature bud state. Although I have not seen the type specimen of *L. leiantha* KURZ the description is wholly fit for Sumatran plants, at which MERRILL has already hinted.

**4. *Lonicera malayana*** HENDERSON, J. Fed. Mal. Stat. Mus. 11 (1924) 187; RIDL, Fl. Mal. Pen. 5 (1925) 313; STEEN, Blumea 6 (1948) 243; HENDERSON, Mal. Nat. J. 6, 1 (1950) 189, f. 170.

Scrambling shrub, branches hirsute by long spreading, and short hairs, intermixed with very few ± sessile glandular-capitate hairs. Leaves oblong-elliptic, not bullate, but nerves and reticulations impressed above, base rounded, apex short-acuminate, 6–11 by 2¾–5 cm, glabrous above except the base of the midrib, spreading-hirsute underneath on nerves and reticulations, and with short-stalked, sparse capitate-glandular hairs, edge ± flat, fimbriate by ± 2 mm long hairs; nerves 5–6 pairs; petiole 5–7 mm, yellow-hairy. Peduncles axillary, 1½–3½ cm, yellow-hairy, 2-flowered. Bracts linear-lanceolate, ± 3 mm, hairy, as long as the ovary, twice as long as the ovate-acuminate, 1½–2 mm similar bracteoles. Flowers hairy, white fading to pale yellow, 5–6 cm long. Calyx-tube urceolate,

drying bluish, glabrous, teeth linear, hirsute, 1½–2 mm long. Corolla-tube 3½–4½ cm long, very thin (1–1½ mm diam.), straight, hirsute by reflexed rather appressed, setaceous yellow hairs, eglandular, yellow-strigose inside, upper lip strongly inrolled-recurved, ± 15 by 3½–4 mm, lobes ovate blunt, ± 2 mm, lower lip spreading, ca 6 by 1 mm. Filaments glabrous, ± 2½ cm exserted, anthers 3 mm, linear. Style glabrous, long-exserted, 7½–8 cm, stigmatic knob distinct.

Distr. ?Hainan, in *Malaysia*: Malay Peninsula (Pahang), twice collected.

Ecol. Scrambling over bushes by Bertam River, ca 1000 m, fl. April–June.

Notes. My former referring this *sp.* provisionally to *L. pulcherrima* has been entirely wrong; it is perfectly distinct from all other Malaysian *spp.* The affinity of this *sp.* seems to be with the E. Asiatic *L. affinis* HOOK. & ARN., *L. similis* HEMSLE., and *L. macrantha* SPR. From *L. siamensis* GAMBLE differing by long-exserted stamens and style, from *L. similis* and *macrantha* by thinner, eglandular corolla. F. C. HOW & N. K. CHUN 70187 from Hainan seems an exact match.

**5. *Lonicera pulcherrima*** RIDL, J. Mal. Br. R. As. Soc. 1 (1923) 64; MERR. Contr. Arn. Arb. 8 (1934) 165; STEEN, J. Arn. Arb. 27 (1946) 449, *excl. syn.*; Blumea 6 (1948) 244.

Climbing or scrambling, branches short-tomentose. Leaves ovate, blunt or acute, base shortly narrowed, glabrous above, short glaucous-tomentose beneath, nerves and reticulations impressed above, 3–7½ by 1½–5½ cm. Petiole tomentose, ½–1½ cm. Flowers in terminal-congested, many-flowered leafy panicles exceeding the leaves, stalks and flowering parts with subsessile, red, capitate-glandular hairs interspersed in the tomentum. Bracts narrow-lanceolate, 2 mm, tomentose. Bracteoles ± orbicular, ± 1 mm, shorter than the ovary, tomentose. Calyx-tube ellipsoid, glabrous except near the apex, lobes lanceolate, as long as the tube, 1½–2 mm. Corolla pale yellow turning orange with age, tube 2–2½ cm, slender, subangular, tomentose, lips ± 1¼–1¾ cm, upper lip incised to ¼–1/5. Stamens far exsert, filaments sparsely hairy towards the base, anthers 3 mm. Style far exsert, glabrous or occasionally with a few negligible, spreading hairs.

Distr. ?China, in *Malaysia*: Sumatra (Atjeh, Tapanuli, Eastcoast).

Ecol. Streamborders, forest borders, open rocky places, 850–1400 m, fl. Sept.–Febr.

Notes. Seems to occur in continental Asia and should be compared with *L. leschenaultii* WALL. from India. *L. reticulata* (non RAFIN.) CHAMP. from Kiangsi (LAU 4649) seems to be an exact match.

**6. *Lonicera acuminata*** WALL. in ROXB. Fl. Ind. 2 (1824) 176; DC. Prod. 4 (1830) 334; MIQ. Ann. Mus. L.B. 2 (1866) 270; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1880) 10; REHDER, Ann. Rep. Mo. Bot. Gard. 14 (1903) 150; STEEN, J. Arn. Arb. 27 (1946) 445; Blumea 6 (1948) 244.—*Caprifolium loureiri* BL. Bijdr. 13 (1826) 653.—*L. loureiri* DC. Prod.



Fig. 1. a. *Lonicera acuminata* WALL.  $\times \frac{3}{4}$ , b. *Lonicera javanica* DC.  $\times \frac{3}{4}$ , c. *Carlemannia tetragona* Hook. f., fruit  $\times 4$ , d-g. seeds of *Sambucus*: d. *S. canadensis* L., e. *S. adnata* WALL., f. *S. javanica* BL., g. *S. coerulea* RAFIN., all  $\times 5$ .

4 (1830) 334; HASSK. Flora 28 (1845) 241, incl. var. *oblonga*; HOOK. Ic.Pl. 9 (1852) t. 806, incl. var. *major*; HOOK. f. & TH. J. Linn. Soc. Bot. 2 (1858) 172; REHDER, Ann. Rep. Mo. Bot. Gard. 14 (1903) 149; KOORD. Exk. Fl. Java 3 (1912) 287; BACKER, Bekn. Fl. Java em. ed. 8 (1949) fam. 175, p. 2.—*L. flavesces* JUNGH. Java ed. 2, neerl. 2 (1854) 407, nomen.—*L. oxylepis* MIQ. Fl. Ind. Bat. 2 (1856) 125, incl. var. *oblonga* (HASSK.).—*L. leschenaultii* (non WALL.) MIQ. l.c. 126.—*L. henryi* HEMSL. J. Linn. Soc. 23 (1888) 359; REHDER, l.c. 148.—*Caprifolium henryi* O.K. Rev. Gen. 1 (1891) 274.—*C. acuminatum* incl. var. *normale*, *loureiroi*, *oxylepis* O.K. Rev. Gen. 1 (1891) 273.—*L. giraldi* REHDER, l.c. 150.—*L. rehderi* MERR. Govt Lab. Publ. (Philip.) 29 (1905) 49; Philip. J.Sc. 5 (1910) Bot. 391; En. Philip. 3 (1923) 578.—*L. philippinensis* MERR. Philip. J.Sc. 1 (1906) Suppl. 240.—*L. transarisanensis* HAYATA, Ic. Pl. Form. 6 (1916) 25.—*L. vestita* W.W.SM. Not. R. Bot. Gard. Edinb. 10 (1917) 49.—*L. mindanaensis* MERR. Philip. J.Sc. 20 (1922) 471.—*L. 'javanica* DC.

, DOCT. v. LEEUWEN, Verh. Kon. Ak. Wet. A'dam 31 (1933) 235–237, f. 61–62, pro forma ♀.—Fig. 1a, 2.

Woody climber or scrambling shrub. Twigs patently hirsute. Internodes rather short. Leaves ovate-oblong to lanceolate, variable in shape, base rounded, truncate or subcordate, apex acute to acuminate, texture often bullate by impressed nerves and reticulations, both sides green, hairiness in various degrees but midrib above always hairy,

3–8 by  $1\frac{1}{2}$ –4 cm; petiole patent-yellow hairy,  $\frac{1}{4}$ –1 cm. Cymes mostly contracted towards the twigs, infl. not exceeding the leaves. Peduncle densely patent-hirsute, sometimes with few sessile glands. Bracts 5–8 mm rarely shorter, narrow triangular, as long as or longer than the ovary. Bracteoles 2 mm, acute oblong, shorter than the ovary. Calyx green, lobes ciliate, with a few stiff hairs on the back. Corolla  $2\frac{1}{2}$ –2 cm long, sulphureous, not fragrant, rather thick and club-shaped in bud, in anthesis upper lip erect, lower lip reflexed; tube glabrous or with few reflexed strigose hairs, sometimes with few sessile glands. Style  $\pm$  as long as the corolla, mostly hairy. Stamens mostly hairy. Berry black.

Distr. India to S. China and Formosa, in *Malaysia*: Sumatra, Java, Bali, Philippines (Luzon).

Ecol. Forest borders, thickets, ericoid crooked forest, mossy forest, 1800–3300 m, fl. Jan.–Dec.

Vern. *Ki seroh*, S.

Notes. Both *L. acuminata* and *L. javanica* show the remarkable 'mass-elevation effect' (cf. J. Arn. Arb. 27 (1946) 447; Fl. Mal. 4 (1949) xlix, f. 37): Cf. fig. 3. In Java the species exclude each other altitudinally, and represent vicarious species (fig. 3). On the summit of Mt Pangrango, W. Java, DOCTERS VAN LEEUWEN studied the variability (l.c.). He noted the occurrence of ♀ fls the anthers of which do not contain pollen. He also mentioned the insect pollination by *Bombus*. Part of his observations belong to *L. javanica*. Aberrative forms

I found in the herbarium are with 3-verticillate leaves, and others with occasionally flowers in triads. A duplotype in fruit at Kew leaves no doubt about the identity of *L. mindanaensis* MERR.



Fig. 2. *Lonicera acuminata* WALL. on summit of Mt Pangrango, W. Java (DOCTERS VAN LEEUWEN).

7. *Lonicera javanica* (BL.) DC. Prod. 4 (1830) 333; MIQ. Fl. Ind. Bat. 2 (1856) 125; REHDER, Ann. Rep. Mo. Bot. Gard. 14 (1903) 157; KOORD. Exk. Fl. Java 3 (1912) 287; DOCT. v. LEEUWEN, Proc. Kon. Ak. Wet. A'dam 31 (1933) 237, f. 60 *pro forma* ♂; STEEN. J. Arn. Arb. 27 (1946) 450; BACKER, Bekn. Fl. Jav. em. ed. 8 (1949) fam. 172 p. 2.—*Caprifolium javanicum* BL. Bijdr. 13 (1826) 653.—Fig. 1b.

Slender, twining. Ultimate twigs short-hairy, mixed with capitate-glandular hairs, internodes soon glabrate, shiny-brown, rather long. Leaves ovate to obovate, or ovate-oblong, base truncate, rounded or cordate, apex acute to acuminate, upperside glabrous or the base of the midrib hairy, beneath glaucous, short-pubescent, 4–11 by 2–6½ cm; petiole ½–1 cm, pubescent. Inflorescences short-grey-hairy, mixed with distinctly stalked capitate-glandular hairs, terminal and in the upper axils so as to form a rather lax, leafy panicle, exceeding the leaves; lower branches up to 6 cm, with reduced leaves, upper internodes not abbreviated. Flowers creamy, fragrant, later fading into yellowish. Bracts linear-lanceolate, as long as or longer than the calyx. Bracteoles ovate, shorter than the ovary. Calyx purplish, lobes lanceolate, 1½–2 mm, the lobes mostly rather densely grey-hairy, sometimes only ciliate. Bud club-shaped, thickened end ± ⅓–¼ of the mature bud, often acute. Corolla 18–30 mm (fresh 3–3½ cm) long, the tube slender, 1 mm or thinner, 1–2 cm, lobes narrow, 8–14 mm long, ± 1–2⅓ mm broad, during anthesis both lips recurved, lobes as long as the tube or shorter; hairs on the corolla recurved, except the capitate glandular

ones. Anthers thin, 2–4 by ⅓–½ mm. Stamens protruding, glabrous. Style often longer than the corolla, glabrous, exserted. Berry dark purple, ripe prob. black.

Distr. *Malaysia*: Java, Lesser Sunda Islands (Bali), Philippines (Mindanao).

Ecol. Forests and forest borders, 1000–2000 m; cf. the note under *L. acuminata*.

Vern. *Ki seroh*, S, *gauod-bukid* (Buk.).

Notes. Apparently closely allied to *L. glabrata* DC. and *L. affinis* HOOK. & ARN. from continental Asia, and in some respects to *L. macrantha*. The density of pubescence is very variable, ranging from hairy forms to almost glabrous ones; leaf-shape and size also vary, even on one twig from ovate to obovate. Pubescence of calyx-teeth varies from ciliate to tomentose. Occasionally 3-lobed leaves occur on young shoots. Sometimes 4-flowered cymes are observed.

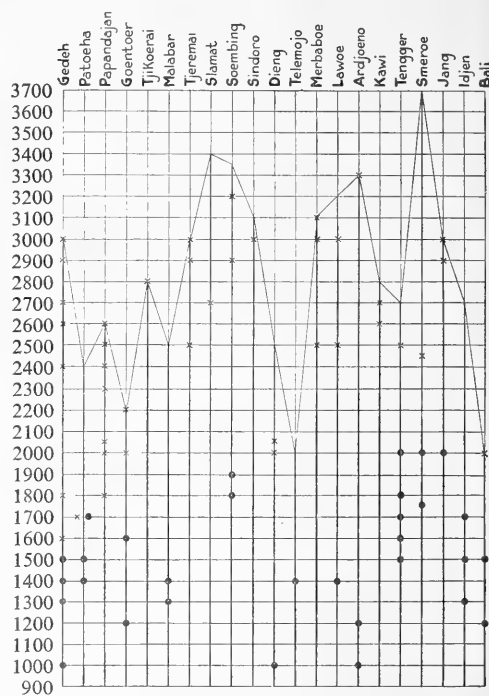


Fig. 3. Altitudinal localities (in metres) of *Lonicera acuminata* WALL. (x) and *L. javanica* (.) in Java and Bali. Mountains arranged from W towards E. Thickened vertical lines indicate the altitude of the summits.

## 2. VIBURNUM

LINNÉ, Sp.Pl. (1753) 267; BL. Bijdr. 13 (1826) 655; MIQ. Fl. Ind. Bat. 2 (1856) 119; BOERL. Handl. 2<sup>2</sup> (1891) 3; K. & V. Bijdr. 5 (1900) 36; KING & GAMBLE, J. As. Soc. Bengal 72<sup>2</sup> (1903) 112; KOORDERS, Exk. Fl. Java 3 (1912) 285; MERR. En.

Philip. 3 (1923) 577; RIDL. Fl. Mal. Pen. 2 (1923) 1; BACKER, Bekn. Fl. Java, em. ed. 8 (1949) fam. 175, p. 2; KERN, Reinw. 1 (1951) 107.

Shrubs or small trees. *Leaves* petiolate, simple, entire or serrate-dentate or trifid, pinnate- or palmate-nerved, (in the Malaysian species) exstipulate. Inflorescence terminal, compound, corymbiform or paniculate, primary rays usually whorled, flowers cymosely arranged. Bracts and bracteoles usually small, caducous. *Flowers* actinomorphic, the marginal ones sometimes (not in Malaysia) radiant, neutral. Calyx 5-lobed or 5-partite. Corolla white, creamy or pink, rotate, campanulate, hypocrateriform or tubular; lobes 5, imbricate in bud. Stamens 5; filaments narrow. Ovary 1-celled. Ovule anatropous, pendulous from the apex, solitary. Style short, conical; stigmas 3, often connate. *Fruit* a drupe, crowned by the persistent calyx and style, 1-seeded. Endocarp horny or stony, in cross-section often undulate or with inflexed edges. Albumen often ruminant.

Distr. Large genus; several hundred, often polymorphous species in Europe, Asia, and America, 16 spp. in Malaysia.

Uses. None of the Malaysian species are known to be of importance economically.

Wood anat. MOLL & JANSSONIUS, Mikr. Holzes 4 (1920) 5. *V. coriaceum*: M. & Js. p. 19, *V. sambucinum*: p. 20, *V. lutescens*: p. 11.

Notes. For a satisfactory identification both flowers and ripe fruits are required, a condition rarely found in the herbarium. From 3 spp. flowers are unfortunately hitherto unknown.

The stellate hairs mentioned to occur in some spp. are apparently not properly stellate but fasciculate hairs (cf. McATEE, Bull. Torrey Bot. Cl. 48, 1921, 149 seq.).

KEY TO THE SPECIES  
(for flowering specimens)

As the flowers of *V. amplificatum*, *V. cornutidens* and *V. clemensae* are unknown, these species have been omitted.

1. Leaves triple-nerved. Tube of corolla hairy within . . . . . 15. *V. propinquum*
1. Leaves penninerved. Tube of corolla glabrous within.
  2. Corolla squamulose without. All young parts densely covered with minute rusty-coloured peltate scales. Leaves entire, the underside at first densely covered with minute scales, later on densely punctulate . . . . . 6. *V. punctatum*
  2. Corolla quite glabrous or pubescent without, sometimes gland-dotted, but not squamulose. Young parts without peltate scales.
    3. Corolla pubescent without, rotate, tube very short, about 1/2 mm long, lobes 1 mm. Filaments 1 1/2-2 mm long. Young branchlets ferrugineous-pubescent . . . . . 16. *V. luzonicum*
    4. Adult leaves pubescent . . . . . var. *luzonicum*
    4. Adult leaves nearly glabrous except for the midrib.
      5. Leaves nearly entire . . . . . var. *apoense*
      5. Leaves strongly dentate.
        6. Apex of leaves acute to shortly acuminate. . . . . var. *floribundum*
        6. Apex of leaves slenderly acuminate. . . . . var. *sinuatum*
  3. Corolla glabrous or gland-dotted without, tube at least 1 mm long.
    7. Filaments adnate to the throat of the corolla. Corolla shortly salvershaped-campanulate, limb horizontally spreading, finally reflexed; tube 2-3 mm long, lobes 2 mm . . . . . 13. *V. odoratissimum*
    7. Filaments adnate to the base or the tube of the corolla. Shape of the corolla different.
      8. Ovary pubescent. Corolla glabrous, tube 1-1 1/2 mm long, lobes 1-2 mm. Filaments 5-7(-9) mm. Leaves large, 10-25 by 5-10 cm, coriaceous, entire . . . . . 7. *V. sambucinum*
      9. Ovary and axes of inflorescence densely pubescent.
        10. Underside of leaves glabrous except for a few hairs on the nerves . . . . . var. *sambucinum*
        10. Underside of leaves villous . . . . . var. *tomentosum*
    9. Ovary and axes of inflorescence subglabrous . . . . . var. *subglabrum*
  8. Ovary not pubescent.
    11. Corolla distinctly tubular, tube at least 3 times as long as lobes, the latter about 1 mm, erect.
      12. Leaves quite entire, underside with distinct glandular pit at the base on both sides of midrib, apex obtuse or shortly and bluntly acuminate. Filaments inserted at base of corolla, 7-8 mm long . . . . . 2. *V. beccarii*
      12. Leaves usually distinctly dentate, sometimes nearly entire, underside bearded in nerve-axils, but without glandular pits, apex mostly gradually long-acuminate. Filaments usually about 4 mm long . . . . . 1. *V. coriaceum*

13. Tube of corolla 3–4 mm long. Filaments about 4 mm long, adnate  $1\frac{1}{2}$ –1 mm above base of corolla . . . . . *var. coriaceum*
13. Tube of corolla about 6 mm long. Filaments up to 6 mm long, adnate 2–3 mm above base of corolla . . . . . *var. longiflorum*
11. Corolla not distinctly tubular, tube less than 3 times as long as lobes, the latter usually more than 1 mm long.
14. Inflorescence shortly pyramidal, paniculate. Corolla rotate-campanulate, tube about 1 mm long. Filaments 2–3 mm long.
15. Leaves thinly coriaceous. Corolla 2–2 $\frac{1}{2}$  mm long. Filaments inserted at base of the corolla. (Between 500 and 1500 m altitude, sometimes up to 2300 m) . . . . . **10. *V. lutescens***
15. Leaves manifestly coriaceous. Corolla 3 mm long. Filaments adnate to the corolla  $1\frac{1}{2}$ –1 mm above the base. Without fruits hardly distinguishable from *V. lutescens*. (Altitude at least 2300 m) . . . . . **11. *V. junghuhnii***
14. Inflorescence corymbiform. Tube of the corolla usually exceeding 1 mm. Filaments at least 6 mm long.
16. Filaments 6(–7) mm long, in bud with inflexed top.
17. Corolla shortly tubular-turbinate, globular in bud, tube about 2 mm, lobes  $1\frac{1}{2}$ –2 mm. Leaves gradually long-acuminate . . . . . **4. *V. platyphyllum***
17. Corolla broad-tubular, obovoid in bud, tube about 2 $\frac{1}{2}$  mm, lobes about  $1\frac{1}{2}$  mm. Leaves obtuse or shortly and bluntly acuminate . . . . . **3. *V. glaberrimum***
16. Filaments (8–)9–10 mm long, serpentine in bud.
18. Leaves dull, hispidulous on the midrib and the primary side-nerves at the underside, without glandular pits. Corolla rotate-cupular, tube 1(– $1\frac{1}{2}$ ) mm, lobes 2–2 $\frac{1}{2}$  mm. . . . . **8. *V. hispidulum***
18. Leaves shining, glabrous, with distinct glandular pits at the base. Corolla turbinate, tube  $2\frac{1}{2}$ –3 mm, lobes  $1\frac{1}{2}$ –2 mm . . . . . **9. *V. vernicosum***

KEY TO THE SPECIES  
(for fruiting specimens)

1. Leaves triple-nerved. Fruits nearly globose, 4–5 mm long, 4 mm wide . . . . . **15. *V. propinquum***
1. Leaves penninerved. Fruits usually compressed, if not, more than 5 mm long.
2. Endocarp with strongly incurved edges, ventral side deeply intruding, embracing an internal split or cavity.
3. Fruit oblong, 16 by 7 mm. Internal cavity of the fruit bilobate in cross-section. Leaves entire, glabrous, elliptic-oblong to slightly obovate, up to 26 by 12–13 cm . . . . . **12. *V. amplificatum***
3. Fruit smaller.
4. Leaves minutely papillose-rugulose, entire. Ventral side of endocarp forming a narrow split, central cavity at most  $\frac{1}{2}$  mm in diameter . . . . . **14. *V. clemensae***
4. Leaves smooth, usually dentate or serrate. Central cavity of fruit about 2 mm wide.
5. Fruit ovoid, 6–7 by 4–5 mm. Internal cavity of fruit nearly circular in cross-section. Leaves dentate to nearly entire . . . . . **13. *V. odoratissimum***
5. Fruit obovoid, 7–9 by 5–7 mm. Internal cavity of the fruit broad, bilobate in cross-section. Leaves closely crenate-dentate . . . . . **11. *V. junghuhnii***
2. Endocarp undulate in cross-section, *i.e.* with shallow grooves on both sides, without internal split or cavity.
6. Leaves quite entire.
7. All young parts densely covered with minute peltate scales. Underside of the leaves at first densely covered with minute scales, later on densely punctulate. Fruit elliptic to somewhat obovoid, 9–11 by 6–7 mm . . . . . **6. *V. punctatum***
7. Young parts without peltate scales.
8. Ripe fruit small, 5–6(–6 $\frac{1}{2}$ ) mm long.
9. Leaves usually ovate-lanceolate, gradually long-acuminate. Fruit ovoid to broad-ellipsoid, 6(–6 $\frac{1}{2}$ ) by 5–6 mm. . . . . **1. *V. coriaceum***
9. Leaves broader, ovate to obovate, obtuse or shortly and bluntly acuminate. Fruit about 5 by 5 mm, ovate to nearly orbicular . . . . . **3. *V. glaberrimum***
8. Ripe fruits larger (without flowers hardly determinable).
10. Nerve-axils and leaf-base without glandular pits or spotty glands. Midrib and primary nerves somewhat hispidulous beneath. Young branchlets and axes of infructescence glabrous or sparingly hispidulous. Young fruits glabrous . . . . . **8. *V. hispidulum***
10. Nerve-axils and/or leaf-base at underside glandular pitted or with (sometimes indistinct) spotty glands. Midrib and primary nerves not hispidulous.
11. Young branchlets densely pubescent. Axes of the inflorescence pubescent, glabrescent. Young fruits thinly pubescent, soon glabrescent. Underside of leaves at the base with a (sometimes indistinct) spotty gland on both sides of midrib . . . . . **7. *V. sambucinum***
12. Axes of the infructescence densely pubescent, later on glabrescent.

13. Underside of leaves glabrous except for a few hairs on the nerves . . . . . *var. sambucinum*  
 13. Underside of the leaves villous . . . . . *var. tomentosum*  
 12. Axes of the infructescence nearly glabrous . . . . . *var. subglabrum*  
 11. Young branchlets and axes of infructescence glabrous to somewhat (not densely) pubescent. Young fruits glabrous.  
 14. Leaves large, up to 22 by 10 cm, ovate to oblong-ovate, apex gradually narrowed into an elongated and slender acumen . . . . . 4. *V. platyphyllum*  
 14. Leaves smaller, obtuse or shortly and bluntly acuminate.  
 15. Young axes of the inflorescence pubescent, glabrescent. Young parts not vernicose. Primary nerves at the underside of the leaves little prominent . . . . . 2. *V. beccarii*  
 15. Infructescence quite glabrous. Young parts vernicose. Primary side-nerves at the underside of the leaves prominent . . . . . 9. *V. vernicosum*  
 6. Leaves dentate or serrate (sometimes superficially).  
 16. At least the midrib of the leaves pubescent. Leaves chartaceous, rarely subcoriaceous. Fruit ovate, much compressed, 5–7 by 5–6 mm, ripening red (always?) . . . . . 16. *V. luzonicum*  
 17. Adult leaves pubescent . . . . . *var. luzonicum*  
 17. Adult leaves nearly glabrous except for the midrib.  
 18. Leaves nearly entire . . . . . *var. apoense*  
 18. Leaves strongly dentate.  
 19. Apex of the leaves acute to shortly acuminate . . . . . *var. floribundum*  
 19. Apex of the leaves slenderly acuminate . . . . . *var. sinuatum*  
 15. Leaves glabrous (sometimes bearded in the nerve-axils), more or less coriaceous. Fruit ripening purplish or bluish black.  
 20. Leaves thickly coriaceous, beneath with shallowly sunken glands in the nerve-axils, margins conspicuously corniculate-dentate. Fruit broadly ovate, 8 by 6–7 mm . . . . . 5. *V. cornutidens*  
 20. Not combining these characters.  
 21. Infructescence shortly paniculate. Fruit oblong-elliptic, 7–10 by 4–5 mm or still larger. . . . . 10. *V. lutescens*  
 21. Infructescence corymbiform. Fruit more ovate or ovoid, smaller.  
 22. Leaves usually ovate-lanceolate, gradually long-acuminate, distinctly dentate. Fruit 6(–6½) by 5–6 mm . . . . . 1. *V. coriaceum*  
 22. Leaves broader, ovate to obovate, obtuse or shortly and bluntly acuminate, nearly entire. Fruit 5 by 5 mm . . . . . 3. *V. glaberrimum*

1. *Viburnum coriaceum* BL. Bijdr. 13 (1826) 656; DC. Prod. 4 (1830) 329; HASSK. Flora 3 (1845) 242; MIQ. Fl. Ind. Bat. 2 (1856) 120, Suppl. (1860) 213; OERSTED, Vid. Meddel. Kjöb. 1860 (1861) 300, t. 6 f. 5–6; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1880) 5; K. & V. Bijdr. 5 (1900) 38; KOORD. Exk. Fl. 3 (1912) 285; KOORD. Fl. Tjib. 32 (1918) 37; DANGUY in Fl. Gén. I.C. 3 (1922) 8; KERN, Reinw. 1 (1951) 115. —*V. forbesii* var. FAWC. in FORBES, Wand. (1885) 507. —*V. cylindricum* HAM. ex D. DON *sensu* REHDER in SARGENT, Trees & Shrubs 12 (1908) 112; BACKER, Bekn. Fl. Java em. ed. 8 (1949) fam. 175, p. 3.—Fig. 4a-f.

Shrub or small tree up to 15 m. Young parts thinly stellate-pubescent. Leaves coriaceous, somewhat shining, glabrous above, often bearded in the nerve-axils on the underside, ovate to lanceolate, 10–24 by 4–8 cm, apex mostly gradually long-acuminate, base rounded or somewhat acute, margins superficially remotely dentate to rather densely serrate-dentate, sometimes almost entire; primary nerves 5–7 on each side, indistinctly anastomosing; petiole 2½–4 cm. Inflorescence umbellate, corymbiform, up to 10 cm across; axes thinly stellate-pubescent; peduncle short, up to 2½ cm; primary rays 5–7. Bracts and bracteoles small, ovate. Flowers somewhat scented. Calyx-limb obscurely toothed, 1½–2 mm diam., teeth triangular, acute. Corolla tubular, ellipsoid-obovoid in bud, creamy white to white, sometimes pink without, usually dotted with brown; tube 3–4 mm, lobes erect, rounded trian-

gular, 1 mm. Stamens exserted; filaments with inflexed top in bud, white, adnate to the corollatube ½–1 mm above the base, about 4 mm long; anthers oblong, purplish, 1–1½ mm. Ovary cylindrical, glabrous or lepidote, 1½–2 mm long. *Drupe* ovoid to broad-ellipsoid or nearly spheric, slightly compressed, bluish black, 6–6½ by 5–6 mm; endocarp undulate in cross-section, dorsally 2-grooved, ventrally 3-grooved, lateral grooves often obsolete.

Distr. SE. Asia, in *Malaysia*: Sumatra, Java, Lesser Sunda Islands (Bali, Lombok, Flores, Timor).

Ecol. In open primary and secondary forests, especially in forest borders, sometimes in brushwood or in grassy plains, from 1000 (especially 1500) m upward, often common and one of the pioneers in natural reforestation. *Fl. fr.* Jan.-Dec.

Vern. Often noticed names: *kiapu*, *kikukuran*, *S. tementilan*, *meniran*, *J.*

Notes. Extremely variable in all its parts, mainly in leaf shape.

*var. longiflorum* KERN, l.c. Tube of corolla 6–7 mm long, lobes 1 mm. Filaments about 6 mm long, adnate to the corolla 2–3 mm above the base.

Distr. *Malaysia*: Sumatra (Eastcoast).

2. *Viburnum beccarii* GAMBLE, J. As. Soc. Bengal 722 (1903) 114; HALIER f. Med. Rijksherb. 14 (1912) 37; RIDL. J. Fed. Mal. St. Mus. 8 (1917) 44; Fl. Mal. Pen. 2 (1923) 2; KERN, Reinw. 1 (1951)



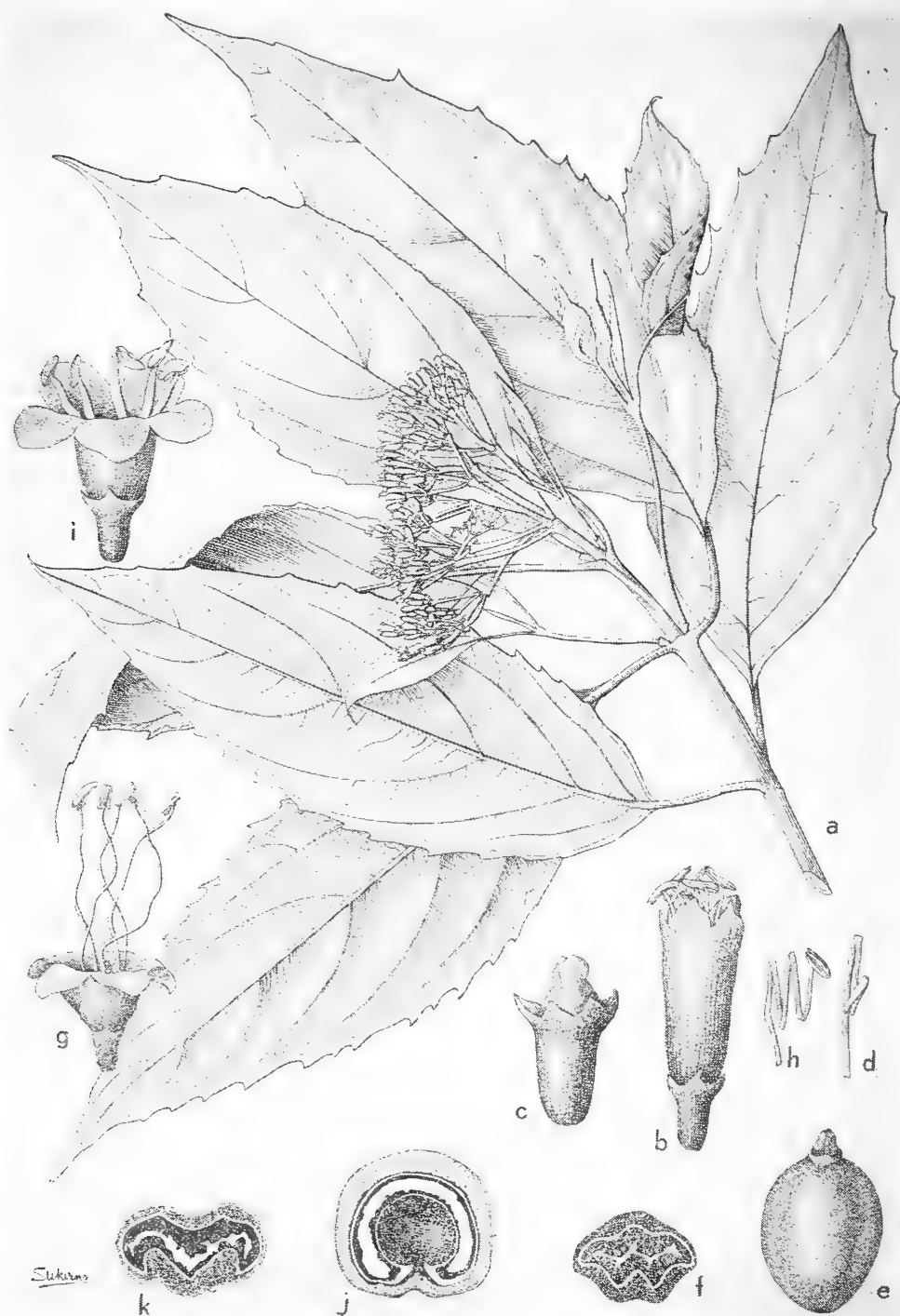


Fig. 4. *Viburnum coriaceum* BL. a. Flowering twig, b. flower, c. ovary, d. aestivation of stamen, e. fruit, f. cross-section through fruit,—*V. sambucinum* BL., g. flower, h. aestivation of stamen,—*V. odoratissimum* KER, i. flower, j. cross-section through fruit,—*V. lutescens* BL., k. cross-section through fruit.

120, f. 2.—*Viburnum* sp. MERR. Contr. Arn. Arb. 8 (1934) 164.

Spreading or climbing shrub or small tree up to 8 m. *Leaves* coriaceous, upperside glabrous, underside minutely gland-dotted and with a distinct glandular pit at the base on both sides of the midrib, often smaller glands in the nerve-axils; elliptic, obovate or ovate, 8–15 by 5–8 cm, apex obtuse or shortly and bluntly acuminate, rarely somewhat emarginate, base cuneate to nearly rounded, margins entire; midrib prominent beneath, primary nerves much less prominent, 4–8 on each side, arcuately anastomosing; petioles 1½–3½ cm. *Inflorescence* corymbiform, umbellately branched, 6–12 cm across (in fruit up to 15 cm), young axes rather densely brown stellate-pubescent, glabrescent; peduncle rather stout, up to 12 cm; primary rays 5–8. Bracts and bracteoles small, linear-lanceolate, rusty stellate-pubescent. Calyx-limb cupular, obscurely lobed, minutely gland-ciliate, otherwise glabrous. Corolla tubular, obovoid-ellipsoid in bud, white; tube 3–4 mm, lobes erect, rounded to rather acute, minutely gland-ciliate, 1 mm. Stamens long-exserted, with inflexed top in bud, inserted at base of corolla, 7–8 mm; anthers oblong, purplish, about 2 mm. Ovary cylindric, glabrous, 2 mm long. *Drupe* ovate, compressed, (young) bluish green, 9–10 by 6–7 mm. Endocarp undulate in cross-section, dorsally 2-grooved, ventrally 1-grooved.

Distr. *Malaysia*: Malay Peninsula (Perak, Pahang) and Sumatra (Atjeh, Eastcoast, Westcoast). Ecol. In forests and thickets, 1100–1900 m.

3. *Viburnum glaberrimum* MERR. Philip. J.Sc. 4 (1909) Bot. 329; En. Philip. 3 (1923) 577; KERN, Reinw. 1 (1951) 122.

Small tree, nearly glabrous. *Leaves* coriaceous, shining, glabrous except for the bearded (or glandular pitted) nerve-axils on the underside, ovate or elliptic, (6–)8–15 by (3–)6–8 cm, apex broadly and obtusely acuminate to nearly rounded, base rounded or slightly decurrent-cuneate, margins entire or remotely undulate-dentate; nervation rather prominent beneath; primary nerves 6–8 on each side, anastomosing; petiole 2–4 cm. *Inflorescence* umbellate, corymbiform, 5–10 cm across, axes thinly stellate-pubescent, glabrescent; peduncle stout, 2–4 cm long; primary rays 5–7. Bracteoles very small, caducous before anthesis. Calyx-limb obscurely lobed. Corolla broad-tubular, obovoid in bud, glabrous, tube about 2½ mm, lobes erect, rounded, about 1½ mm. Stamens exserted; filaments adnate to base of corolla, in the flower-bud inflexed at the top, about 6 mm; anthers oblong, 1½–2 mm. Ovary cylindric, glabrous, 1 mm long. *Drupe* ovate to nearly orbicular, compressed, 5 by 5 mm. Endocarp obscurely undulate in cross-section, with 2 shallow dorsal grooves and 1 shallow ventral groove.

Distr. *Malaysia*: Philippines (Luzon, Mindanao).

Ecol. In primary forests; altitude according to MERRILL (1909 *l.c.*) 300–450 m, according to MERRILL (1923) *l.c.*, 1000–1400 m.

Note. Closely allied to *V. coriaceum*, which is unknown from the Philippines. The differences are presumably sufficient to justify specific separation. The corolla of *V. coriaceum* is more distinctly tubular, the corolla-bud more ellipsoid. The stamens of *V. glaberrimum* are inserted at the base of the corolla, those of *V. coriaceum* somewhat adnate to the tube; the filaments are 6 mm long, those of *V. coriaceum* reach this length only in some large-flowered specimens.

4. *Viburnum platyphyllum* MERR. Philip. J.Sc. 10 (1915) Bot. 284; KERN, Reinw. 1 (1951) 123, f. 3.—*V. pachyphyllum* MERR. *sphalm.* En. Philip. 3 (1923) 577.

Tall tree, nearly glabrous. *Leaves* firmly chartaceous to subcoriaceous, somewhat shining, pale olivaceous when dry, glabrous, ovate to oblong-ovate, 9–22 by 4–10 cm, apex gradually narrowed to the usually elongated and rather slender acumen, base obtuse to somewhat acute, margins entire to obscurely undulate; primary nerves 6–7 on each side, somewhat prominent beneath, indistinctly anastomosing, axils on the lower surface (often also axils of coarser secondary nerves) glandular-pitted; petioles 4–5 cm, of the smaller leaves 1–2 cm. *Inflorescence* large, umbellate, corymbiform, up to 18 cm across, axes thinly stellate-pubescent, glabrescent; peduncle 4–6 cm long; primary rays about 7. Flowers numerous, fragrant. Calyx-limb with short but distinct triangular teeth. Corolla globular in bud, when open shortly tubular to somewhat turbinate, gradually slightly widened towards the top, white, glabrous, tube 2–2½ cm, lobes erect, rounded, 1½–2 mm. Stamens exserted; filaments inserted at base of corolla, in the flower-bud with inflexed top, sometimes moreover with a distinct fold in the lower part, 6–7 mm; anthers oblong, 2 mm. Ovary cylindric, glabrous, 1 mm long. *Drupe* oblong-ovate, compressed, 8–9 by 6 mm. Endocarp slightly undulate in cross-section, with 2 dorsal grooves and 1 ventral groove.

Distr. *Malaysia*: Philippines (Leyte).

Ecol. In forests, at about 500 m.

Note. Very closely allied to *V. glaberrimum*, from which it is possibly not specifically different. The main differences are the much larger leaves with slender acumen (also smaller-leaved forms occur), the more distinct calyx-teeth, the shape of the corolla (widened to the top, in *V. glaberrimum* broad-tubular) and the larger fruits.

5. *Viburnum cornutidens* MERR. Philip. J.Sc. 26 (1925) 491; En. Philip. 4 (1926) 251; KERN, Reinw. 1 (1951) 125.

Small, glabrous tree, about 5 m high. *Leaves* thickly coriaceous, shining, olivaceous or brownish olivaceous, obovate to elliptic, 10–14 by 7–10 cm, apex rounded to shortly and obtusely acuminate, base acute, margins conspicuously corniculate-dentate, teeth straight, obtuse, 1–2 mm long, chiefly terminating the primary nerves, these about 9 on each side, nearly straight, once (sometimes twice) forked, beneath with glandular pits in the axils; petioles 2–3½ cm long. *Infructescence* umbellate,

corymbiform, about 15 cm across; peduncle stout, about 5 cm long; primary rays 5–7. *Drupe* broadly ovate, compressed, 8 by 6–7 mm. Endocarp slightly undulate in cross-section, dorsally 2-grooved, ventrally 1-grooved.

Distr. *Malaysia*: Philippines (Luzon, only known from Mt Baudan).

Ecol. On forested slopes at  $\pm$  1800 m.

Vern. *Manano* (Igorot).

Note. Flowers unknown. Like *V. platyphyllum* an ally of *V. glaberrimum*. The species is (sufficiently?) characterized by the thickly coriaceous, broad, dentate leaves and the broadly ovate fruits.

**6. *Viburnum punctatum* HAM. ex D. DON, Prod. Fl. Nepal. (1825) 142; DC. Prod. 4 (1830) 324; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1880) 5; DANGUY in Fl. Gén. I.C. 3 (1922) 12; KERN, Reinw. 1 (1951) 127.—*V. acuminatum* WALL. ex DC. Prod. 4 (1830) 325; W. & A. Prod. 1 (1834) 388; WIGHT, Icones 3 (1845) 13, t. 1021.**

Shrub or small tree up to 18 m. Young parts densely covered with minute, rusty-coloured, peltate scales, leaving numerous punctiform scars when they fall off. *Leaves* coriaceous, upper surface glabrous, underside densely covered with minute scales, neither bearded nor glandular-pitted in the nerve-axils, elliptic-lanceolate to lanceolate, 5–13 by 2–4½ cm, apex bluntly acuminate, base attenuate, margins entire; primary nerves 5–7 on each side, rather prominent beneath, anastomosing; petioles 1–1½ cm. Inflorescence umbellate, corymbiform, 5–10 cm across (infructescence up to 15 cm), axes densely squamulate; peduncle very short, 1–3 cm; primary rays 3–5. Bracts and bracteoles minute, ovate-lanceolate, fimbriate. *Flowers* fragrant, about 5 mm wide. Calyx-teeth ovate-triangular, obtuse, light-margined, squamulate, about ¾ mm long. Corolla white, glabrous within, squamulate without, globular in bud, nearly rotate (only slightly campanulate) when open, tube 1 mm, lobes broad-ovate, rounded, somewhat overlapping, 2 mm. Stamens somewhat exserted; filaments in bud with inflexed top, inserted near base of corolla, 3–4 mm; anthers elliptic, 1 mm. Ovary cylindric, lepidote, 1½–2 mm long. *Drupe* elliptic or slightly obovate, much compressed, young squamulose, ripening black, 9–11(–12) mm by 6–7 mm. Endocarp undulate in cross-section, with 2 dorsal and 3 ventral grooves.

Distr. SE. Asia, from Nepal, Kumaon and the Deccan to Siam and Indochina, in *Malaysia*: N. Sumatra (Atjeh), twice collected.

Ecol. Secondary growths, 800–1000 m.

**7. *Viburnum sambucinum* BL. Bijdr. 13 (1826) 656; DC. Prod. 4 (1830) 325; MIQ. Fl. Ind. Bat. 2 (1856) 120; HASSK. Bonpl. 7 (1859) 170; OERSTED, Vid. Meddel. Kjöb. 1860 (1861) 299, t. 7, f. 11–13; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1880) 5, 671; K. & V. Bijdr. 5 (1900) 40; GAMBLE, J. As. Soc. Bengal 72 (1903) 113; KOORD. Exk. Fl. 3 (1912) 285; KOORD. Fl. Tjib. 32 (1918) 38; MERR. J. Str. Br. Roy. As. Soc. 86 (1921) 582; DANGUY in Fl. Gén. I.C. 3 (1922) 11; RIDL. Fl. Mal. Pen. 2 (1923) 1; CORNER, Way-**

side Trees (1940) 183; BACKER, Bekn. Fl. Java, em. ed. 8 (1949) fam. 175, p. 4; KERN, Reinw. 1 (1951) 129.—*V. integririmum* WALL. Cat. 457; HOOK. f. & TH. J. Linn. Soc. 2 (1858) 176.—*V. forbesii* FAWC. in FORBES, Wand. (1885) 506, excl. var. —Fig. 4 g–h, 5.

Shrub or small tree, up to 10–(15) m. Young branchlets densely stellate-pubescent. *Leaves* more or less coriaceous, glabrous except for a few hairs on the nerves and the bearded nerve-axils at the underside (see var. 2), here with an often indistinct spotty gland at the base on both sides of midrib, elliptic-oblong to oblong-lanceolate, 10–25 by 5–10 cm, apex abruptly short-acuminate, base cuneate, margins entire; nervation rather prominent beneath; primary nerves 5–7 on each side, anastomosing; petioles up to 4 cm long. *Inflorescence* densely many-flowered, umbellate, corymbiform, up to 15–18 cm across, axes densely stellate-pubescent; peduncle stout, 4–6 cm long; primary rays 6–8. Bracts and bracteoles small, linear-lanceolate, stellately pubescent. *Flowers* small, 3–4 mm diam., very fragrant. Calyx-limb with ovate-triangular, acute, ciliate lobes, ¾–1 mm long. Corolla rotate or campanulate, globular in bud, white or creamy, tube 1(–1½) mm, lobes spreading, ovate, rounded, (1–)1½(–2) mm, usually tube somewhat shorter than lobes, not rarely the reverse. Stamens long-exsert; filaments almost filiform, serpentine in bud, inserted at base of corolla, (4–)5–7(–9) mm; anthers elliptic to oblong, ¾–1 mm. Ovary cylindric, usually densely hairy, 1–1½ mm long. *Drupe* ovate, much compressed, young thinly hairy, glabrescent, ripening bluish black, (7–)9(–10) by (5–)6(–7) mm. Endocarp undulate in cross-section, dorsally 2-grooved, ventrally 3-grooved, lateral ventral grooves often obsolete.

Distr. Cambodia, in *Malaysia*: chiefly in the western part, often frequent, Malay Peninsula, Sumatra, Borneo, Java (rare in the central and eastern part), Lesser Sunda Islands, Celebes and the Moluccas, but here presumably very rare (Ceram).

Ecol. Open primary and secondary forests, in brushwood, particularly at forest-edges in the lower mountain zone (up to 1800 m), occasionally in swampy places in the lowlands. *Fl. fr.* Jan.–Dec.

Vern. *Ki kukuran*, *ki bewog*, *S*, *bleber*, *J*, and many other local names.

var. *subglabrum* KERN, Reinw. 1 (1951) 130.—*V. longistamineum* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 151; Fl. Mal. Pen. 2 (1923) 2; SYMINGTON, J. Mal. Br. R. As. Soc. 143 (1936) 353. Inflorescence small, 5–7 cm across. Axes of inflorescence and ovary subglabrous.

Distr. *Malaysia*: Malay Peninsula, 1100–1800 m.

var. *tomentosum* HALLIER f. Med. Rijksherb. 14 (1912) 36; KERN, Reinw. 1 (1951) 130, f. 4.—*V. sumatranum* MIQ. Fl. Ind. Bat. Suppl. (1860) 537.—*V. villosum* RIDL. J. Str. Br. Roy. As. Soc. no 61 (1912) 10; Fl. Mal. Pen. 2 (1923) 2.—*V. inopinatum* CRAIB,



Fig. 5. *Viburnum sambucinum* BL. G. Pantjar, West Java (DE VOOGD).

Kew Bull. (1911) 385; DANGUY in Fl. Gén. I.C. 3 (1922) 10.

Underside of the full-grown leaves softly villous by simple, forked and stellate hairs.

Distr. Siam, in *Malaysia*: Malay Peninsula (Selangor), Sumatra (especially in the northern half), the typical form probably restricted to higher altitudes, 800–1200 m.

**8. *Viburnum hispidulum* KERN, Reinw. 1 (1951) 136, f. 5.**

Tree up to 24 m. *Leaves* coriaceous, dull, glabrous above or somewhat hispidulous on midrib and primary nerves, hispidulous beneath, especially on midrib and primary side-nerves, punctulate, neither glandular-pitted nor bearded in nerve-axils, elliptic to elliptic-oblong or obovate, 12–17 by 8–9 cm, apex abruptly shortly and bluntly acuminate (acumen up to 5 mm), base cuneate to broadly cuneate, margins entire; nervation prominent beneath; primary nerves 5–7 on each side, anastomosing; petioles 2–6 cm. *Inflorescence* umbellate, corymbiform, 10–15 cm across; peduncle short, up to 5 cm; primary rays 6–7; bracteoles firm, ovate to lanceolate, gland-dotted, ciliate, 4–6 mm long. Calyx-limb cupular, glabrous, obscurely lobed, 1 mm long. Corolla (creamy) white, globular in bud, rotate-cupular when open, tube 1(–1½) mm,

lobes ovate to oblong, 2–2½ mm. Stamens much exserted; filaments thick, serpentine in bud, inserted at base of corolla, 9–10 mm; anthers oblong, 2 mm. Ovary cylindric, lepidote, 1½ mm long and thick. *Drupe* oblong-elliptic to slightly obovate, compressed, 9–10(–11) by 6–7 mm. Endocarp undulate in cross-section, dorsally 2-grooved, ventrally 3-grooved.

Distr. *Malaysia*: Br. N. Borneo (Mt Kinabalu), ± 2000 m.

Note. Differs from *V. vernicosum* mainly by its dull hispidulous leaves, the absence of glandular pits at the leaf-base and the rotate-cupular corolla.

**9. *Viburnum vernicosum* GIBBS, J. Linn. Soc. 42, Bot. (1914) 86; MERR. En. Born. (1921) 582; KERN, Reinw. 1 (1951) 139, f. 6.**

Shrub or small glabrous tree, up to 10 m. Young parts very shining, vernicose. *Leaves* coriaceous, shining, chiefly on underside densely punctulate and gland-dotted, beneath with distinct glandular pit at the base on both sides of midrib and often smaller ones in higher nerve-axils, elliptic to slightly obovate, 12–18 by 6–11 cm, apex shortly and abruptly acuminate (acumen up to 1 cm long), base acute, margins entire; primary nerves 5–7 on each side, prominent beneath, anastomosing. Petioles 1–3 cm. *Inflorescence* umbellate, corymbiform, up

to 11 cm across; peduncle stout, up to 6 cm long; primary rays 5–7; bracteoles firm, oblong to lanceolate, with membranous margins, gland-dotted, 5–7 mm long. Calyx-limb obscurely lobed. Corolla creamy white, gland-dotted on outside, turbinate, obovoid in bud, tube  $2\frac{1}{2}$ –3 mm, lobes erect, rounded triangular,  $1\frac{1}{2}$ –2 mm. Stamens much exserted; filaments thick, serpentine in bud, inserted at base of corolla, (8)–9–10 mm; anthers oblong, 2 mm. Ovary cylindric, lepidote, vernicose, 1– $1\frac{1}{2}$  mm long. *Drupe* ovate, compressed, purplish black, 10 by 7–8 mm. Endocarp undulate in cross-section, (often irregularly) 2-grooved on dorsal side, 3-grooved on ventral side, lateral grooves often nearly absent.

Distr. *Malaysia*: Borneo.

Ecol. Primary and secondary forests, 900–2700 m.

Note. Very polymorphous species. The above description refers to what presumably may be called the common form. Specimens with larger, elliptic fruits (12–14 by 7–8 mm), others with broad-elliptic leaves (14–16 by 9–11 cm) were also collected.

**10. *Viburnum lutescens* BL.** Bijdr. 13 (1826) 655; DC. Prod. 4 (1830) 325; MAXIM. Mém. Biol. 10 (1880) 651; GAMBLE, J. As. Soc. Bengal 72 (1903) 114; KOORD. Ekk. Fl. 3 (1912) 286; KOORD. Fl. Tjib. 32 (1918) 38; RIDL. Fl. Mal. Pen. 2 (1923) 2; CORNER, Wayside Trees (1940) 183; BACKER, Bekn. Fl. Java em. ed. 8 (1949) fam. 175, p. 5; KERN, Reinw. 1 (1951) 142.—*V. monogynum* BL. Bijdr. 13 (1826) 655.—*V. sundaicum* MIQ. Fl. Ind. Bat. 2 (1856) 121; K. & V. Bijdr. 5 (1900) 43.—*V. colebrookianum* (non WALL.) DANGUY, Fl. Gén. I.C. 3 (1922) 9.—? *V. elegans* JUNGH. Nat. Gen. Arch. 2 (1845) 36.—Fig. 4k.

Shrub or small tree, up to 10 m, usually much lower. Youngest parts thinly stellate-pubescent. *Leaves* thinly coriaceous, upperside glabrous, underside thinly stellate-pubescent to almost glabrous, very variable in shape, broad-elliptic, ovate or oblong-elliptic, up to 18 by 10 cm, apex short-acuminate, base nearly rounded to cuneate, margins in upper  $\frac{2}{3}$  coarsely crenate-serrate to finely serrate, teeth shortly mucronate, lower  $\frac{1}{3}$  entire or superficially dentate; nervation rather prominent beneath; primary nerves 5–8 on each side, indistinctly anastomosing; petioles 1–2 cm. *Inflorescence* terminal or spuriously lateral, paniculate, short-pyramidal, 5–9 cm across, 5–7(–10) cm long; axes stellate-pubescent, glabrescent; primary branches 4–7, verticillate. Bracts and bracteoles minute, stellate-pubescent. *Flowers* somewhat fragrant, 4–5 mm wide. Calyx-teeth ovate-triangular,  $\frac{3}{4}$  mm long. Corolla globular in bud, nearly rotate (only slightly campanulate) when open, creamy white, glabrous, tube  $\frac{3}{4}$ –1 mm, lobes ovate, rounded,  $1\frac{1}{4}$ – $1\frac{1}{2}$ (–2) mm. Stamens somewhat exserted, filaments inserted near base of corolla, in bud with inflexed top, white, 2–3 mm; anthers elliptic, sordidly white, 1 mm. Ovary cylindric, glabrous, 1– $1\frac{1}{2}$  mm long. *Drupe* oblong-ellipsoid, somewhat oblique, slightly compressed, ripening

purplish-black, 7–10 by 4–5 mm (rarely 11–12 by 7–8 mm: Borneo, Malay Penins.). Endocarp undulate in cross-section, with 2 dorsal and 1 ventral groove.

Distr. SE. Asia, in *Malaysia*: Malay Peninsula (local), Borneo (few times), Sumatra, Java, Lesser Sunda Islands (Bali, Lombok).

Ecol. Primary and secondary forests, brushwood, often common but scattered, usually 500–1500 m, rarely lower (–150 m) or higher (one record of 2400 m from Mt Patuha). *Fl.* fr. Jan.–Dec.

Vern. Many native names have been recorded, e.g. *ki rantja*, *ki kukuran*, *ki bewog*, Sd, *tjèrè*, *wuru watu*, *J, kapor-kaporan*, *porkaporan*, Md, *kaju nassi* (Sum.).

Uses. Sometimes cultivated as a hedgeplant, easily propagated by cuttings. Ripe fruits are readily eaten by birds.

**11. *Viburnum junghuhnii* MIQ.** Fl. Ind. Bat. 2 (1856) 123; K. & V. Bijdr. 5 (1900) 47; KOORD. Ekk. Fl. 3 (1912) 286; BACKER, Bekn. Fl. Java 8 em. ed. (1949) fam. 175, p. 4; KERN, Reinw. 1 (1951) 147, f. 7.—*V. lutescens* (non BL.) HALLIER f. Med. Rijks-herb. 1 (1911) 15 p.p.

Subarborescent shrub or small tree, up to 18 m. *Leaves* coriaceous, broad-elliptic, obovate-elliptic to nearly lanceolate, apex rounded or shortly acuminate, base more or less attenuate, closely crenate-dentate, teeth apiculate, glabrous, (4)–8–12  $\frac{1}{2}$  by 3–6 cm; nervation very prominent beneath; primary nerves 5–7 on each side, anastomosing; petioles  $1\frac{1}{2}$ –2  $\frac{1}{2}$ (–4) cm. *Inflorescence* terminal or pseudolateral, paniculate, short-pyramidal, up to 5 cm long and 8 cm wide; lower ramifications 3–5-nately whorled, upper ones alternate; peduncle 3–6 cm; bracteoles small, lanceolate to ovate. *Flowers* fully 5 mm wide, fragrant. Calyx-limb 1 mm long, distinctly toothed, teeth ovate-triangular. Corolla creamy white, globular in bud, rotate-campanulate when open, glabrous, tube short, fully 1 mm, lobes up to 2 mm, ovate, rounded. Stamens hardly exserted; filaments in bud with inflexed top, inferior part adnate to corolla  $\frac{1}{2}$ –1 mm, free part  $1\frac{1}{2}$ –2 mm; anthers elliptic, 1 mm. Ovary cylindric, glabrous, 2 mm long. *Drupe* obovoid, 7–9 by 5–6 mm, compressed. Endocarp in cross-section slightly undulate and with strongly incurved edges, ventral side therefore deeply intruding, embracing a broad, bilobate cavity.

Distr. *Malaysia*: Sumatra (Westcoast: Mt Korintji), Java.

Ecol. Forests, 2300–2600 m.

**12. *Viburnum amplificatum* KERN,** Reinw. 1 (1951) 150, f. 8.—*Viburnum* sp. MERR. Pl. Elm. Born. (1929) 297.

Shrub-like tree. *Leaves* thinly coriaceous, dull, dark olivaceous above, brown beneath, glabrous, neither glandular pitted at the base nor bearded in the nerve-axils, elliptic-oblong to slightly obovate, up to 26 by 12–14 cm, apex abruptly short-acuminate (acumen rather blunt,  $\frac{1}{2}$ –1 cm), base cuneate to somewhat rounded, margins entire, sometimes distantly and obscurely undulate; nervation prom-

inent beneath; primary nerves 5–7 on each side, anastomosing; petioles 2–4 cm. *Infructescence* umbellate, corymbiform, about 13 cm diam.; peduncle stout, about 7 cm; primary rays 7–8. *Drupe* oblong, very slightly dilated upwards, much flattened, with a distinct groove on both sides, black, 16 by 7 mm. Endocarp with broad longitudinal groove on the dorsal side, the incurved edges forming a deep, broad, in cross-section bilobate furrow on the ventral side.

Distr. *Malaysia*: Br. N. Borneo (Tawao).

Note. Flowers unknown. The species is readily recognizable by its large leaves and fruits and by the cross-section of the endocarp, reminding one of *V. junghuhnii*.

**13. *Viburnum odoratissimum* KER.** Bot. Reg. 6 (1820) t. 456; DC. Prod. 4 (1830) 326; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1880) 7; MAXIM. Mém. Biol. 10 (1880) 645, 649; REHDER in SARGENT, Trees and Shrubs 2 (1908) 127; K. & V. Bijdr. 5 (1900) 46; KOORD. Exk. Fl. 3 (1912) 286. — *V. zambalense* ELM. Leaflet. Philip. Bot. 9 (1934) 3181. — Fig. 4 i–j.

Shrub or small tree, sometimes up to 20 m, glabrous, only youngest parts with few stellate hairs. *Leaves* more or less coriaceous, dull or somewhat shining, glabrous or underside with few scattered stellate hairs and somewhat bearded in the nerve-axils, elliptic-oblong to oblong-lanceolate or obovate, 8–15 by 3–7 cm, apex shortly and bluntly acuminate, rarely rounded or emarginate, base attenuate, margins in the upper half obsolete (sometimes distinctly) toothed or nearly entire, cartilaginous; nervation prominent beneath; primary nerves 5–7 on each side, indistinctly anastomosing; petioles ( $1\frac{1}{2}$ )–1–2 cm. *Inflorescence* paniculate, more or less elongated pyramidal, up to 10 cm long and wide, many-flowered; axes slightly stellate-pubescent; peduncle 2–5 cm, primary branches verticillate, divaricate; bracteoles linear-lanceolate, ciliate, 1–3 mm long. *Flowers* fragrant, 5–6 mm wide. Calyx-limb cupular, 1 mm long, teeth broad-triangular, glabrous or sparsely ciliate. Corolla obovoid to ellipsoid-obovoid in bud, shortly funnel-shaped-campanulate when open, creamy white, glabrous or sometimes with some stellate hairs on outside, tube gradually widened upwards, 2–3 mm, limb horizontally spreading, finally reflexed, lobes broad-ovate, rounded, somewhat overlapping, 2 mm. Stamens exserted, filaments adnate to corolla-throat, in bud with inflexed top, 2–3 mm; anthers oblong,  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm. Ovary glabrous,  $1\frac{1}{2}$ –2 mm long. *Drupe* ovoid, 6–7 by 4–5 mm, purplish-black. Endocarp dorsiventrally compressed and strongly incurved, edges nearly touching, ventral side strongly concave, embracing a cavity of  $1\frac{1}{2}$ –2 mm diam. Seed strongly compressed, falcate in cross-section, 1 mm thick.

Distr. Eastern India to Indo-China, E. China & Formosa, northward to Japan, in *Malaysia*: Philippines (Luzon, Mindoro, Panay, Negros, Ley-

te, Mindanao), Celebes. The record for W. Java (Mt Pangrango, KUHL & VAN HASSELT) is presumably a misstatement; it has not been retraced there.

Ecol. Primary forests, ravines, thickets, etc., 1000–2000 m. *Fl. fr.* Jan.–Dec.

Note. The above description has only reference to the Malaysian form. The widespread species is extremely variable both in the shape of the leaves and in the flowers.

**14. *Viburnum clemensae* KERN, Reinw. 1 (1951) 157, f. 10.**

Small glabrous tree. *Leaves* coriaceous, dull, in dry state olivaceous above, yellowish or brownish green beneath, minutely papillose-rugulose all over (under the lens), underside glandular-pitted both in the axils of the primary and secondary nerves, elliptic to oblong-lanceolate or slightly obovate,  $9\frac{1}{2}$ – $11\frac{1}{2}$  by  $3\frac{1}{2}$ – $5\frac{1}{2}$  cm, often inequilateral and somewhat falcate, apex abruptly short-acuminate to nearly caudate, rarely rounded, base cuneate, margins entire, cartilaginous; nervation prominent beneath, primary nerves 4–5 on each side, anastomosing; petioles  $1\frac{1}{2}$ –2 cm. *Infructescence* nearly sessile, small (4–8 cm long), paniculate, lowest branches ternate, middle ones opposite, upper ones alternate. Bracteoles minute, lanceolate. *Drupe* ellipsoid or oblong-ovoid, not compressed, 10 by 6–7 mm, shining, calyx-teeth persistent, triangular,  $\frac{3}{4}$  mm long. Mesocarp thin, scanty fleshy. Endocarp strongly incurved, dorsal side orbicular in cross-section, edges touching, ventral side folded to an internal longitudinal crest  $2\frac{1}{2}$ –3 mm broad, slightly widened at the upper margin, here embracing a cavity of about  $\frac{1}{2}$  mm diam. Seed compressed, reniform in cross-section, 2 mm thick.

Distr. *Malaysia*: Br. N. Borneo (Mt Kinabalu).

Note. Flowers unknown. Easily distinguishable from *V. odoratissimum* by the minutely rugulose leaves and the smaller number of primary side-nerves, but mainly by the size of the fruit and the quite different cross-section of the endocarp.

**15. *Viburnum propinquum* HEMSLEY, J. Linn. Soc. 23 (1888) 355; REHDER in SARGENT, Trees and Shrubs 2 (1908) 33, 133, pl. 115; MERR. En. Philip. 3 (1923) 578; KERN, Reinw. 1 (1951) 160. — *V. valerianicum* ELM. Leaflet. Philip. Bot. 7 (1915) 2578.**

Shrub. *Leaves* thinly coriaceous, glabrous except for the bearded axils of primary side-nerves on the underside, ovate to ovate-lanceolate, often somewhat falcate, 6–8 (–11) by  $2\frac{1}{2}$ –4 (– $5\frac{1}{2}$ ) cm, apex acute to long-acuminate, base cuneate to broadly cuneate, margins on both sides  $\frac{1}{2}$ –1 (–2) cm above the base with an impressed small gland, nearly entire, only minutely and distantly serrulate, teeth reduced to mucros hardly  $\frac{1}{2}$  mm long; nervation prominent beneath, basal primary nerves nearly as prominent as the midrib (leaves therefore triple-nerved), more apical 2–3 pairs less prominent, all side-nerves anastomosing; petioles 1–2 cm. *Inflorescence* umbellate, corymbiform, (3)–5–7 cm across, axes glabrous; peduncle short, 2 (–5) cm; primary rays 5–7. Bracts and bracteoles minute, ovate, ciliate. Calyx-limb 1 mm long, obscurely lobed; lobes ovate, obtuse,



glabrous, about  $1\frac{1}{2}$  mm. *Corolla* whitish or yellowish green, 4 mm wide, campanulate-rotate, globular in bud; tube broad, scarcely 1 mm long, hairy within, lobes ovate to oblong, rounded, recurved in anthesis,  $1\frac{1}{2}$  mm. Stamens exserted; filaments adnate near base of corolla, in bud with inflexed top,  $2-2\frac{1}{2}$  mm; anthers broadly elliptic,  $\frac{3}{4}$  by  $\frac{1}{2}$  mm. Ovary  $\frac{3}{4}$ -1 mm long and wide, glabrous. *Drupe* globose-ovoid, bluish black, 4-5 by 4 mm. Mesocarp thin, scanty fleshy; endocarp thin, orbicular in cross-section, ventrally slightly 1-grooved. Seed ovoid; albumen deeply ruminant.

Distr. China (Hupeh) and Formosa, in *Malaysia*: Philippines (Luzon: Rizal, Benguet).

Ecol. Mossy forest, 2200-2450 m.

Notes. The triplernerved leaf with marginal glands (reminding one of those of *Vaccinium* spp.), the hairy corolla-tube, the achenoid drupe and the peculiar cross-section of the endocarp characterize this species; it stands isolated among the other Malaysian *Viburnums*. According to ELMER l.c. the strong odour, especially in cured specimens, is that of *Valeriana*. The same fact had already been stated by HALLIER in *V. sambucinum*, *V. coriaceum* and *V. lutescens*. VAN ITTALIE ascertained the presence of valerianic acid in *V. sambucinum*. On this ground HALLIER supposed the close relationship of *Viburnum* with the *Valerianaceae* (Med. Rijksherb. 14 (1912) 36; *op. cit.* 37 (1918) 92).

16. *Viburnum luzonicum* ROLFE, J. Linn. Soc. 21 (1884) 310; VIDAL, Phan. Cuming. (1885) 117; Rev. Pl. Vasc. Philip. (1886) 147; REHDER in SARGENT, Trees & Shrubs 2 (1908) 97, pl. 146; MERR. Philip. J.Sc. 5 (1910) Bot. 391; DANGUY in Fl. Gén. I.C. 3 (1922) 13; MERR. En. Philip. 3 (1923) 577; KERN, Reinw. 1 (1951) 161.—*V. laxum* ELM. Leaf. Philip. Bot. 7 (1915) 2576.

Shrub 3-6 m high. Ultimate ramifications (often densely) ferrugineous-pubescent. *Leaves* extremely variable, chartaceous to subcoriaceous, young ones pubescent by simple antrorse and stellate hairs, more or less glabrescent, 3-8(-13) by 2-5 cm, ovate to lanceolate, apex acute to long acuminate, base broadly cuneate to rounded, often inequilateral, margins almost entire to sinuate-dentate in upper part; nervation prominent beneath, often hidden by indument; primary nerves 5-7 on each side, usually terminating in teeth, lower ones anastomosing; petioles densely pubescent,  $\frac{1}{2}$ -1 cm. *Inflorescence* terminal or spuriously lateral, umbellate, corymbiform to semi-globose, 3-5 cm across, axes densely ferrugineous pubescent; peduncle very short, up to 2 cm; primary rays 3-6. Bracts and bracteoles small, lanceolate, pubescent and ciliate,

1-2 mm. *Flowers* slightly odorous, 3-5 mm wide. Calyx hardly 1 mm long, deeply lobed, lobes ovate-lanceolate, pubescent. *Corolla* rotate, globular in bud, creamy white or somewhat pink, strigose and stellate-pubescent without, glabrous within, tube very short ( $\frac{1}{2}$  mm), lobes elliptic-oblong, rounded,  $1\frac{1}{2}$ -2 mm. Stamens exserted, but shorter than corolla-lobes; filaments adnate to base of corolla,  $1\frac{1}{2}$ -2 mm; anthers broadly elliptic, yellow,  $\frac{1}{2}$ - $\frac{3}{4}$  mm long. Ovary cylindric, densely pubescent, 1 mm long. *Drupe* ovate, much compressed, red (or ripening black?), (5-)6-7 by 5-6 mm. Endocarp slightly undulate in cross-section, the 2 dorsal and 3 ventral grooves often obsolete.

Distr. China & Indo-China to Formosa, in *Malaysia*: Philippines, Moluccas (Buru).

Ecol. Thickets and forests, 800-2200 m. *Fl. fr.* Jan.-Dec.

Vern. Many local names have been noticed, e.g. *atálba*, *tilba* (Ig.), *atiba* (Bon.), *bangas-bangas* (Bag.), *bagiroro* (Bik.), *putud* (Gad.).

var. *apoense* ELM. Leaf. Philip. Bot. 7 (1915) 2577; MERR. En. Philip. 3 (1923) 577; KERN, Reinw. 1 (1951) 162.

Leaves subcoriaceous, nearly glabrous except for midrib, ovate-lanceolate, apex long-acuminate, acumen often falcate, margins nearly entire; primary nerves often anastomosing.

Distr. *Malaysia*: Philippines (Luzon?, Mindanao).

Vern. *Angganasi*, *atadatud* (Buk.), *bangas-bangas* (Bag.).

var. *floribundum* (MERR.) KERN, Reinw. 1 (1951) 163.—*V. floribundum* MERR. Philip. J.Sc. 4 (1909) Bot. 328; En. Philip. 3 (1923) 577.

Leaves chartaceous, nearly glabrous except for midrib and primary nerves, ovate, apex acute to shortly acuminate, margins rather strongly dentate in upper half, primary nerves for the greater part terminating in teeth.

Distr. *Malaysia*: Philippines (Luzon).

var. *sinuatum* (MERR.) KERN, Reinw. 1 (1951) 163.—*V. sinuatum* MERR. Gov. Lab. Publ. 35 (1906) 65; Philip. J.Sc. 1, Suppl. (1906) 137; En. Philip. 3 (1923) 578.

Leaves oblong-ovate, apex slenderly acuminate, acumen usually falcate, margins coarsely sinuate-dentate; otherwise as var. *floribundum*.

Distr. *Malaysia*: Philippines (Luzon, Negros), Moluccas (Buru).

Vern. *Taringongog* (Neg.).

### 3. SAMBUCUS

LINNÉ, Sp.Pl. (1753) 269; Gen. Pl. (1754) p. 130, no 334; MILLER, Ber. D.B.G. 2 (1884) 452; FRITSCH, Oesterr. B.Z. 39 (1889) 214; DAMMER, *ibid.* 40 (1890) 261; HÖCK, Bot. Centr. Bl. 51 (1892) 233; FRITSCH, *ibid.* p. 81; in E. & P. 4, 4 (1897) 157; SCHWERIN, Mitt. Deut. Dendr. Ges. (1909) 1-56; *op. cit.* (1920) 194.

Trees, shrubs, or erect herbs. Stem and branches pithy, nodes often with stipule-

like appendages. *Leaves* imparipinnate, or incompletely bipinnate, rarely lacinate. Leaflets serrate or divided, opposite or alternate. *Flowers* actinomorphic, articulated with the pedicel, mostly white, in terminal, flat or convex corymbs; flowers sometimes dimorphic: gynodioecious, or part of them aborted into nectarial glands. Bracts mostly absent. Bracteoles 1 or absent. Calyx-tube short, limb 5-parted. *Corolla* rotate, 5-lobed, lobes valvate or imbricate(?). Stamens 5, inserted on the base of the corolla; filaments filiform, erect; anthers oblong, latrorse, cells free, attached in the middle. Ovary 3–5-celled, each cell with 1 ovule; stigmas 3 or 5, short, broad, on a cushion-like style. *Berry* 3–5-seeded. Seeds with  $\pm$  flat sides, back convex, granulate, embryo  $\pm$  as long as the seed, terete.

*Distr.* Ca 10–20 spp., throughout the globe, absent from Oceania, S. & Central Africa, and Australia (except its E. part and Tasmania), centering in the N. hemisphere.

*Uses.* None of the various medicinal uses ascribed to the elder in Europe, Asia, and America is known from Malaysia.

*Notes.* The discrimination of the specific characters as given by VON SCHWERIN is not very satisfactory, specially if only herbarium materials are available. Though the colour of the berry varies rather in several species, it is sometimes accepted for specific delimitation between others. Leaf-shape and indumentum represent variable characters. The size and shape of the seeds may furnish additional specific characters (cf. fig. 1). Among *Caprifoliaceae* it seems that *Sambucus* represents the closest relation to *Valerianaceae*.

Some specimens show well-developed stipules; these are hairy inside towards the base but do not possess collectors.

#### KEY TO THE SPECIES

1. Corymbs with a number of flowers aborted into top-shaped, mostly yellow nectaries. Seeds ovate.

1. *S. javanica*

1. Corymbs without such nectaries. Seeds oblong.

2. Upper 1–2 pairs of leaflets sessile-adnate. Leaves simply pinnate. Berry oblong . . . 3. *S. adnata*

2. Upper leaflets not adnate. Leaves often bipinnate. Berry globular . . . 2. *S. canadensis*

1. *Sambucus javanica* REINW. ex BL. Bijdr. 13 (1826) 657; DC. Prod. 4 (1830) 322; HASSK. Flora 28 (1845) 243; BLANCO, Fl. Filip. (1845) 151, ed. 3, 1 (1877) 271; MIQ. Fl. Ind. Bat. 2 (1856) 124; HK. f. & TH. J. Linn. Soc. Bot. 1 (1857) 180; HOOK. f. Fl. Br. Ind. 3 (1880) 2; BOERL. Handl. 2 (1891) 3; KOORD. Minah. (1898) 492; HUTCH. Kew Bull. (1909) 193; HALL. f. Med. Rijksherb. 14 (1912) 38; KOORD. Exk. Fl. 3 (1912) 285; BUYSMAN, Flora 106 (1914) 115; BOLD. Zakfl. (1916) 43; MERR. Sp. Blanc. (1918) 370; SCHWERIN, Mitt. Deut. Dendr. Ges. 18 (1909) 41, *ibid.* (1920) 222, incl. *var. borealis* SCHWER., *var. formosana* (NAKAI) SCHWER. & *var. meridionalis* SCHWER.; LÖRZING, Trop. Natuur 10 (1921) 103, f. 6; WELSEM, *op. cit.* 181–183; BACK. & SLOOT. Theonkr. (1924) 211; MOORE, J. Bot. (1924) 46; MERR. En. Philip. 3 (1923) 576; Contr. Arn. Arb. 8 (1934) 164; Comm. Lour. (1935) 375; PEI, Bot. Bull. Ac. Sin. 1 (1947) 8; BACK. Bekn. Fl. Java em. ed. 8 (1949) fam. 175, p. 1.—*S. angustifolia* NORONHA, Verh. Bat. Gen. 5 (1790) 85, *nomen*, cf. HASSK. *l.c.*—*S. canadensis* (non L.) THUNB. Fl. Jap. (1784) 126; Fl. Jav. (1825) 5; HASSK. Cat. Hort. Bog. (1844) 117, *an T. & B. ibid.* (1866) 120?—*S. chinensis* LINDL. Trans. Hort. Soc. Lond. 6 (1826) 297; DC. *l.c.*; SCHEFF. Nat. Tijd. N.I. 34 (1874) 41.—*S. thunbergiana* BL. ex MIQ. Ann. Mus. L. B. 2 (1866) 265; KURZ, For. Fl. Burma 2 (1877) 3.—*S. hookeri* REHDER in SARG. Pl. Wils. 2 (1912) 308.—*S. formosana* NAKAI, Bot. Mag. Tokyo 31 (1917) 211.—*Ebulum formosanum*

NAKAI, J. Coll. Sc. Tokyo 31 (1917) 211.—**Fig. 1f.**

Little branched, more or less weedy, erect shrub 1–3½ m. Pith white. Twigs terete, nodes between the petioles often with recurved, rarely foliaceous, stipular appendages. *Leaflets* 2–6-jugate, higher ones often 1–3-foliate, rachis often with foliaceous appendages at the base of the leaflets, uppermost leaflets very rarely adnate to the terminal leaflet and the rachis. Leaflets oblong to linear-lanceolate, shortly stalked to sessile, sometimes adnate to the rachis, base cuneate to cordate, symmetric to oblique, mostly opposite, rarely alternate, apex acuminate, shallowly serrate, lower teeth glandular-swollen, 7–22 by 1½–6½ cm; midrib and base of side-nerve hairy above, hairy or glabrous beneath. *Corymbs* flat-topped, 3–5–(7–) rayed, mostly hairy to subglabrous, with a foliate base, near the branching often with stalked glands. *Part of the fls* deformed into erect, stalked, yellow, orange or sometimes (?) green, top-shaped, persistent, nectaries, 3 mm diam., impressed at the top.<sup>1</sup> Pedicels 0–2 mm. Calyx-tube sulcate lengthwise, lobes triangular, acute, persistent, ½ mm. Corolla white or creamy, fragrant (as in *S. nigra*), (1½–)2½–3½ mm long, lobes acute, valvate in bud, (1–)2–2½ mm. Filaments mostly  $\pm$  ½ mm, as long as the yellow anthers not exceeding the corolla-lobes, the latter spreading, rarely reflexed.

(1) Not galls as DANGUY (F. Gén. I.C. 3, 1922, 4) supposes (*sic!*).



Stigmas 3, narrowed towards the apex. Ovary 3-celled, sulcate. Ripe berry ovoid, black, 3-seeded, 3–4 mm diam. Seeds ovate, pointed 2 mm long.

Distr. SE.—E. Asia, Japan, Formosa, in *Malaysia*: not E. of the line Philippines-Celebes-Lombok, but not yet found in the Malay Peninsula!

Ecol. Everwet primary and secondary forests, thickets, clearings, mostly in  $\pm$  shaded localities, (350–)700–2000 m, fl. fr. Jan.–Dec. The nectaries have been actually found to contain honey. The habit has been described as 'straggling', but this is certainly incorrect.

Vern. *Ki katumpang, ki tamblëg, ki tèspong, bēbēdjaran, S, mantjo, sēngitan, J, galamat, kalamat* (Ig.), *saucó* (Sp.), *sēlando* (Karo-Batak), *Javaanse vlier*, *D, tatamaikang* (Minah.)

Notes. P'EI describes the fruits as red from China. It is quite possible that Malaysian specimens represent some varieties; e.g. I found in a specimen from Sumatra (DOCT. v. LEEUWEN 12831) the petals recurved and filaments twice as long as the anthers instead of as long as these. In hairy young infl. the flowers are mostly subsessile. Along with normal flowers I found sometimes stamens exposed in flowers with apparently aborted corollas. *S. javanica* is, apparently, the only representative of the section *Scyphidanthé* MIQ. *S. hookeri* REHD. does not appear to be different.

2. *Sambucus canadensis* LINNÉ, Sp.Pl. (1753) 269; DC. Prod. 4 (1830) 322; SCHWERIN, Mitt. Deut. Dendr. Ges. (1909) 35; *ibid.* (1920) 215; v. WELSEM, Trop. Natuur 10 (1928) 181–183, *cum ic.*; BRUGGEMAN, Ind. Tuinb. (1939) 263, f. 268; BACKER, Bekn. Fl. Java em. ed. 8 (1949) fam. 175, p. 2.—*S. bipinnata* MOENCH. Meth. Pl. (1794) t. 506, ?*non* SCHL. & CHAM. (1830).—Fig. 1d.

Shrub 1–3½ m, forming subterranean sprouts. Twigs with stipular glandular appendages on the nodes or not, 3–5-jugate, in the larger leaves the lowest 1–2 pairs of leaflets mostly 2–3-foliate, rachis not rarely with small, gland-tipped, leafy appendages; leaflets opposite, ovate to lanceolate, base variable, apex acuminate, base of margin entire, above serrate, 4½–12 by 1½–4 cm; midrib hairy on both sides, underside hairy on the nerves. *Corymbs* 20–45 cm diam., convex, (4–)5-rayed,  $\pm$  glabrous, axes purple. Pedicels 5–6 mm. Flowers feebly fragrant. Calyx-tube 1 mm high, hardly sulcate, lobes ovate, blunt, after anthesis appressed,

in fruit dark purple. Corolla creamy, 4–4½ mm, lobes blunt, often toothed, 3–3½ mm, imbricate in bud. Filaments small in bud, in anthesis 3 mm, spreading. Anthers yellow, oblong. Ovary 5-celled, stigmas 5. Berry globular, subapplanate, shiny black-purple, 4–5 mm diam., (4–)5-seeded. Seeds  $\pm$  2½ mm long, oblong-elliptic.

Distr. N. America, said to have been imported in Java as late as 1918 from Indochina by the Botanic Gardens, Bogor (v. WELSEM, l.c.), but rapidly dispersed in gardens throughout Malaysia as an excellent, often rich-flowering, ornamental.

Ecol. Cultivated, 200–1300 m, fl. Jan.–Dec. The flowers remain opened for several days, they do not produce honey in Java; easily propagated by cuttings; if cut twigs are partly defoliated, the infl. remains fresh for several days.

Vern. *Amerikaanse vlier*, *D, American elder*, E.

Notes. The differences between *S. canadensis* L. and *S. mexicana* PRESL ex DC. [Prod. 4 (1830) 322; STANDLEY, Tr. & Shr. Mexico (1926) 1395;—*S. bipinnata* SCHL. & CHAM. Linnaea 5 (1830) 171; CORNER, Wayside Trees (1940) 182, t. 40] seem slight and both *spp.* were considered conspecific by SARGENT. The main differences are apparently the oblong shape and sulcate surface of the berry in *S. mexicana*. The 2 specimens of *S. mexicana* I could examine had smaller flowers and more roundish anthers than those of *S. canadensis*.

3. *Sambucus adnata* WALL. ex DC. Prod. 4 (1830) 322; HOOK. f. Fl. Br. Ind. 3 (1882) 3; SCHWERIN, Mitt. Deut. Dendr. Ges. (1909) 41; P'EI, Bot. Bull. Ac. Sin. 1 (1947) 7.—Fig. 1e.

Distr. Himalaya to China, ?E. Africa; mountains.

This species does not belong to § *Scyphidanthé* MIQ. though SCHWERIN treated it as such; it is more related to *S. canadensis*. Entirely different from *S. javanica* by absence of nectaries, oblong-elliptic 2½–3 mm long seeds, apparently constantly 1–2 pairs of upper leaflets connate with the rachis, oblong and larger berries (type at Kew!). There is one specimen in Herb. Leiden (899–69–80) said to come from Celebes, but the specimen consists of one leaf only and is too poor for proper identification. Its upper leaflets are adnate, but this is a feature also occurring, though very rarely, in *S. javanica*. I doubt the occurrence of *S. adnata*, which is a native of continental SE. Asia (India to China), in Malaysia.

#### 4. CARLEMANNIA

BENTH. in HOOK. J. Bot. 5 (1853) 307; B. & H. Gen. Pl. 2 (1873) 63; HOOK. f. Fl. Br. Ind. 3 (1880) 85; BAILL. Hist. Pl. 7 (1880) 468; PITARD, Fl. Gén. I.C. 3 (1923) 167; SOLEREDER, Bull. Herb. Boiss. 1 (1893) 173–8; K. SCH. in E. & P. 4, 4 (1897) 31; SOLEREDER, Syst. Anat. Dik. Ergänz. (1908) 173, HALLIER f. in JUST's Bot. Jahrb. 36, 3 (1910) 221; Med. Rijksherb. no 1 (1910) 40; *ibid.* 14 (1912) 38; Arch. Néerl. Sc. Ex. Nat. IIIB, 1 (1912) 224; BREMEKAMP, Rec. Trav. Bot. Néerl. 36 (1939) 372.

Generally little-branched herbs, subglabrous or hairy, apparently erect. Inflorescence with sparse sessile or stalked, capitate-glandular hairs. Leaves mostly

obliquely elliptic, crenate-dentate, parenchyma apparently with glands at the underside. Petioles connected by a raised line, in which no interpetiolar stipule can be distinguished. *Flowers* white, yellowish or pink, in short-peduncled terminal sometimes also axillary corymbs. Calyx-tube globose, constricted at the apex; lobes 4-5, subequal or unequal, persistent. Corolla tubular, club-shaped in bud, circumsciss at the base, lobes 4, rather narrowly imbricate in bud, two outer two inner. *Stamens* 2, inserted in the middle of the tube, alternating with the lobes, dorsifix, cohering in bud and enclosing the style; filaments short, terete or somewhat flattened, extending towards the corolla base but distinctly forming part of the corolla tube; anthers linear, latrorse, included in the tube, relatively large, opened already in bud, connective apiculate. Pollen granular. Disk annular-short-cylindric, consisting of two parts alternating with the ovarial cells, placed below the anthers. *Ovary* 2-celled, each cell with  $\infty$  ovules inserted on a thick basal placenta. Style filiform, included, stigma clavate, erect, 2-fid. *Capsule* membranous,  $\pm$  globular, or more or less pyramidal,  $\pm$  inflated, and 4-lobed, each lobe with a few veins, 2-celled, loculicidally 2-valved. Seeds  $\infty$ , minute, oval, testa smooth(?) or reticulated, albumen granular or horny, embryo minute at the top of the albumen (*ex auct.*).

Distr. Three spp., Himalaya & Mishmi Hills, Tonkin, and Yunnan, in *Malaysia*: Sumatra.

Ecol. Montane forest plants.

Notes. For a discussion on the systematic position compare the notes at the head of the family. HALLIER, after having switched in a few years his opinion from *Gesneraceae* to *Saxifragaceae*, finally agreed with SOLEREDER assigning this genus to *Caprifoliaceae*.

Few figures exist of the genus; that of SCHUMANN is wrong. The flowers are 4-merous and the corolla is definitely imbricate in bud; the number of sepals may vary to 5. The relative large size of the stamens, their coherence in bud enclosing the style, the anther-cells shedding pollen in bud, point to an unusual anthesis, on which no field observations are available. The typical 'glassy' hairs, constricted apex of the calyx, and dorsifix anthers remind of a longitudinal section of the flower of *Dentella*, also a plant without interpetiolar stipules. The capitate-glandular hairs, typical cymose infl. and symmetric flower point towards *Lonicera*, the reduction in the androecium, unknown or extremely rare in *Rubiaceae*, to *Valerianaceae* acc. to BREMEKAMP.

1. *Carlemannia tetragona* HOOK. f. Fl. Br. Ind. 3 (1880) 85; DRAKE in MOROT, J. de Bot. 9 (1895) 215; PITARD, Fl. Gén. I.C. 3 (1923) 168, 159, f. 164-7 incl. var. *tonkinensis*.—*Carlemannia sumatrana* RIDL. J. Str. Br. R. As. Soc. 1 (1923) 66; STEEN. Bull. J.B.B. III, 13 (1934) 246; BREMEKAMP, Rec. Trav. Bot. Néerl. 36 (1939) 372.—*C. henryi* LÉV. in FEDDE, Rep. 13 (1914) 178.—Fig. 1c.

Puberulous delicate herb, 20-50 cm. Stems terete, older nodes articulated. *Leaves* membranous, ovate-oblong to lanceolate, base and apex acute to subacuminate, sparsely white-hairy on both sides, hairs relatively coarse, 4-9 by  $1\frac{1}{2}$ - $3\frac{3}{4}$  cm, primary nerves 5 pairs; petiole  $2\frac{1}{2}$  cm. *Corymbs* terminal, congested to dense, above 2 reduced spatulate leaves,  $\pm 2\frac{1}{2}$  cm diam., puberulous, not or hardly exceeding the leaves, 7- to many-flowered, each pair with a reduced cyme at the base; peduncle 1-2 cm. *Fls* in pairs, only 1 narrow bract resembling the sepals; pedicels 1 mm; no bracteoles observed. Calyx tube hairy, 1 mm; lobes 4-5, linear, erect, hairy, 3-4 mm, exceeding the middle of the mature bud, in fruit 3-nerved, equal. *Corolla* hairy towards the tip by thick glassy hairs on a raised bulbous base, imbricated margins

and inside glabrous, prob. pale, 6- $6\frac{1}{2}$  mm, lobes slightly unequal, the larger ones ovate, rounded,  $\pm 1\frac{3}{4}$  by  $1\frac{1}{2}$  mm. Disk short-cylindric,  $\frac{1}{2}$  mm high, consisting of two parts, margin slightly crenate, lobes below the anthers. Filaments 1 mm, anthers  $2\frac{1}{2}$  mm, linear, opened in bud, their tip just reaching the throat of the corolla. Style filiform, its base fusiform-swollen above the disk, glabrous, 5 mm; stigmatic arms narrow,  $\pm 1$  mm, fibrous, also in opened flowers often sticking to one of the anthers, not exceeding the stamens. *Capsule* 4-5 mm through, distinctly 4-lobed or 4-horny at the base, broader than high. Seeds ovate-oblong, hardly 1 mm, testa reticulate.

Distr. Mishmi Hills (NE. Himalaya), Tonkin, Yunnan in *Malaysia*: NE. Sumatra (mountains above Medan-Deli), apparently local.

Ecol. In forests, 1000-1300 m, fl. Dec.-July.

Notes. Allied to *C. griffithii* Hook. f. which differs by oblong sepals, 1-2 mm, distinctly unequal, and not reaching the middle of the corolla, larger fls, shorter filaments and  $\pm$  globular fruit without distinctly stellate-spreading basal lobes. I have not seen the fruit lobes dehiscing as RIDLEY mentions. The size of the leaves by which the Indochinese variety was distinguished seems of little value. The

type material is in a slightly older state than the Sumatran specimens are, but I am perfectly satisfied about their identity.

#### Excluded

*Lonicera* GAERTN. = *Loranthaceae*.

*Lonicera chinensis* WATS., *L. confusa* DC., *L. javanica* DC., and *L. macrantha* DC. were mentioned to occur in the Philippines by F.-VILLAR, Nov. App. (1880) 104, but these records have been excluded by MERRILL, Gov. Lab. Publ. (Philip.) 29 (1905) 50; En. Philip. 3 (1923) 578.

*Lonicera symphoricarpus* (non L.) BLANCO, Fl. Filip. (1837) 161. = *Scurrula philippinensis* (CHAM. & SCHLECHT.) G. DON, cf. DANSER, Philip. J.Sc. 58 (1935) 121.

*Viburnum zippelii* MIQ. Fl. Ind. Bat. 2 (1856) 122; SCHEFFER, Ann. Jard. Bot. Btzig 1 (1876) 28; HAL-  
LIER f. Med. Rijksherb. 14 (1912) 36 = *V. japonicum* (THUNB.) SPR., wrongly recorded for New Guinea. Cf. KERN, Reinw. 1 (1951) 165.

*Viburnum alternifolium* ZOLL. & MOR. Syst. Verz. (1845-1846) 59 = *Ilex alternifolia* (ZOLL. & MOR.) LOES.

## POLEMONIACEAE (C. A. Backer, Heemstede)

Annual or perennial herbs or shrubs, sometimes climbing by means of foliar tendrils, rarely small trees. *Leaves* spirally arranged or opposite, exstipulate, sessile or petioled, entire or more or less deeply divided, or compound. *Flowers* axillary or terminal, solitary, geminate, corymbose or capitate, actinomorphic or slightly zygomorphic. Calyx 5-lobed or 5-partite, with or without transparent fields, persistent. Corolla gamophyllous, 5-lobed or 5-partite; lobes contorted in bud. Stamens 5, on the corolla-tube, inserted at equal or unequal height, alternating with the segments; filaments free from each other, included or exserted; anthers dorsifixed, 2-celled; cells opening longitudinally. Ovary superior, sessile on a disk, 3 (rarely 2)-celled; ovules in each cell 1- $\infty$ , inserted in the inner angle; style 1, filiform, 3 (rarely 2)-fid. *Fruit* a loculicidal or septifragal capsule, rarely indehiscent. Endosperm mostly copious; embryo straight or slightly curved.

Distr. N. America and the Andes, rare in the Old World, absent from Africa and Australia. Genera 12, represented by upwards of 250 species. In *Malaysia* one American genus is more or less naturalized; a few other species are cultivated in gardens.

Uses. The Indonesian species are exclusively of horticultural value.

### KEY TO THE GENERA

1. Climbing. Leaves pinnate; rachis terminating in a branched tendril. Flowers solitary or pairwise in the leaf-axils, long-peduncled, rather large. Fruit septifragal. . . . . **1. *Cobaea***
1. Not climbing. Tendrils absent. Inflorescence several-flowered. Fruit loculicidal.
  2. Filaments inserted at very unequal height. Leaves entire . . . . . **2. *Phlox*<sup>1</sup>**
  2. Filaments inserted at equal height . . . . . **3. *Gilia*<sup>1</sup>**

### 1. COBAEA

CAV. Icon. 1 (1791) 11.

Climbing shrubs or herbs. *Leaves* spirally arranged, pinnate; rachis ending in a much branched tendril, branches of tendril terminated by a minute sharp claw. Leaflets opposite, herbaceous, usually in 3 pairs, lowest pair quite near the leaf-base. *Flowers* solitary or geminate, axillary or on top of short branch, long pedicelled, rather large. Calyx-tube sometimes well-developed, usually very short; segments valvate with recurved margins, either short and broad or long and narrow. Corolla campanulate, 5-lobed or 5-partite; segments short and broad or long and narrow. Stamens inserted at equal height above the base of corolla-tube; filaments filiform with a thickened hairy base, about as long as corolla or longer, sometimes much longer. Disk thick, 10-lobed. Ovary ovoid-oblong, glabrous; cells 2- $\infty$ -ovuled; style about as long as corolla or longer; style-arms linear. *Capsule* oblong, coriaceous or pergamaceous, septifragal, 3-valved; central column very thick. Seeds in each cell 1- $\infty$ , 2-seriate, peltately attached, large, much compressed, winged all round; testa becoming slimy when steeped in water; cotyledons large, fleshy.

Distr. Species 18, native of tropical America, a few introduced into other countries; one of these has become more or less naturalized in Java.

### KEY TO THE SPECIES

1. Calyx-tube with 5 prominent flat folds; segments not or slightly longer than broad, rounded or retuse with an apical point and broadly reflexed, mutually appressed margins. Corolla-segments much shorter than the tube, broadly triangular, obtuse. Flowers patent or erecto-patent . . . **1. *C. scandens***
1. Calyx-tube without prominent flat folds; segments much longer than broad, acute, with narrowly reflexed, mutually appressed margins. Corolla-segments much longer than the tube, narrowly linear, at the apex divided into 2 very short, narrow segments. Flowers pendulous. . . **2. *C. panamensis***

(1) The genera *Phlox* and *Gilia* are represented in Malaysia by cultivated ornamentals only; they are not further treated here.

1. *Cobaea scandens* CAV. Ic. 1 (1791) 11, t. 16-17; CURTIS, Bot. Mag. (1805) t. 851; POIR. Enc. Méth. Suppl. 2 (1811) 305; BTH. in DC. Prodr. 9 (1845) 322; Fl. des Serres 14 (1861) pl. 1467; BRAND, Pfl. R. 27 (1907) 24, f. 6; BACK. Ann. J.B.B. Suppl. 3 (1909) 399; KOORD. Exk. Fl. 3 (1912) 125; STANDLEY, Contr. U.S. Nat. Herb. 17 (1914) 458; WIGMAN, Teysm. 32 (1921) 50, photo; BRUGGEMAN, Ind. Tuinb. (1939) 155; BACK. Bekn. Fl. Jav. em. ed. 8 (1949) fam. 187, 2.—*Cobaea scandens* ANDR. Bot. Repos. 5 (1803) 342.—*Rosenbergia scandens* HOUSE, Muhlenbergia 4 (1908) 23.—Fig. 1.

Robust perennial climber, 3-8 (up to 20?) m high. Stem angular, glabrous. *Leaflets* in 3 or sometimes 2 pairs, glabrous, obtuse or acute, mucronate; lowest pair subsessile, not stipuliform, oblong-obovate from an obtuse, truncate or emarginate, subequal, often broadened base; higher ones distinctly stalked, ovate to oval or oblong from an obtuse, acute or contracted base,  $3\frac{1}{2}$ -13 by  $1\frac{1}{4}$ -6 cm; lateral nerves confluent into a thin intramarginal nerve; petiolules 1-2 cm. *Flowers* patent or erecto-patent. Peduncle robust, 8-30 cm long, near the base with 2 pinnate bracts. *Calyx* 3-3 $\frac{1}{2}$  cm long, cleft more than halfway down, widely gaping; tube 1-1 $\frac{1}{2}$  cm long, very wide, with 5 strongly prominent flat folds; segments foliaceous, slightly or hardly longer than broad, broadly oval-ovate, rounded or retuse, with a short or longish point, green, pale-veined, glabrous without, very densely short-white-pubescent within. *Corolla* 4 $\frac{1}{2}$ -6 $\frac{1}{2}$  cm long, very wide, lobed much less than halfway down, at first pale green, usually turning darkviolet, rarely not changing its colour; tube slightly constricted above the broad campanulate base, above the constriction gradually widened, outside along the upper margin densely short-pubescent, otherwise glabrous, within with a broad densely villous ring at the insertion of the stamens, otherwise glabrous; segments broadly triangular, rounded or very obtuse. *Stamens* about as long as the corolla or slightly or distinctly longer, often upturned at the apex, filaments glabrous above the pubescent base; style glabrous; style-arms comparatively short, erect or erecto-patent. *Capsule* elliptic-oblong, 5-9 cm long. Seeds numerous, blackish brown,  $\pm 1\frac{1}{2}$  cm long.

Distr. Native of Mexico, Central America and Brazil, in the mountainous districts of Java cultivated as an ornamental and locally met with as an escape from gardens, not truly naturalized, 1200-1800 m. Fl. Jan.-Dec., fr. July-Aug.

2. *Cobaea panamensis* STANDLEY, Contr. U.S. Nat. Herb. 17 (1914) 452.—*C. penduliflora* (non al.) BACKER, Bekn. Fl. Jav. em. ed. 8 (1949) fam. 187, 2.

Herbaceous, climbing, 2-4 m high. Stem very slender, angular, densely white-woolly about the nodes, otherwise glabrous or subglabrous, purplish green; leaf-rachis thin, 4-6 cm (disregarding the apical tendril), glabrous above the pubescent base.

*Leaflets* 3 pairs, subequal, narrowly oblong-oblancoate from an obtuse, rounded or subtruncate base, very acute, thin, light green, obscurely and remotely ciliolate, otherwise glabrous, 3-8 cm by  $3\frac{1}{4}$ -2 $\frac{1}{2}$  cm; petiolules 4-8 mm. *Flowers* solitary, pendulous; peduncle thin, glabrous ebracteate, 6-



Fig. 1. *Cobaea scandens* CAV. as an escape near Tjibodas mountain garden, W. Java (JENSEN).

21 cm. *Calyx* green, glabrous,  $2\frac{1}{2}$ -3 $\frac{1}{2}$  cm long, almost cleft to the base; segments narrowly triangular, acute. *Corolla* (not seen in a living state) deep brownish purple; tube widely campanulate,  $1\frac{3}{4}$ -2 cm long, glabrous outside; inside between the bases of the filaments with a very dense transverse ring of short hairs; segments separated by narrow sinuses, almost linear from a broadened base, very gradually tapering, very shortly bifid,  $\pm 6$  cm long, deep purple. Filaments very thin, purple, much exceeding the corolla, densely short-hairy at the base; anthers purple,  $\pm 1$  cm. Style slender, glabrous, 10-13 cm; stigmas thin,  $\pm \frac{3}{4}$  cm; *capsule* oblong, acute, glabrous, pergamaceous,  $\pm 3\frac{1}{2}$  cm by  $\pm 1\frac{1}{4}$  cm. Seeds 12 or fewer, oval-oblong, broadly winged.

Distr. Native of Central America. A few specimens found naturalized in East Java (Tawang Rĕdjĕni, S of Turen), in a jungle at 400 m alt. where it flowered and fruited freely (May 1927 by the late Dr O. POSTHUMUS); it may be expected to spread further. Other data not available.

Note. In contra-distinction to the description by STANDLEY (*l.c.*) I found the corolla glabrous outside, provided with a ring of hairs within.

## CRASSULACEAE (C. A. Backer, Heemstede)

Herbs or undershrubs, usually succulent, perennial, less often annual or biennial. *Leaves* spirally arranged, opposite or whorled, exstipulate, simple or compound, entire, dentate, crenate, serrate or deeply incised. *Flowers* ♀, rarely unisexual, actinomorphic, usually cymose or cymose-paniculate, rarely spicate or solitary in leaf-axils, pedicelled or sessile, mostly 4-5-, rarely 3- or polymorous. Sepals free or nearly so, or united into a distinct tube, after anthesis marcescent and persistent as are the petals. *Petals* the same number as sepals, rarely more, hypogynous, free or variously connate. Stamens either as many as petals and alternate with them or twice their number, perigynous or all or partly inserted on the corolla; filaments free from each other; anthers 2-celled; cells introrse, dehiscing longitudinally. Hypogynous scales as many as carpels, placed singly at the back of them, free or at the base adnate to the base of the carpels. *Carpels* superior, the same number as petals, epipetalous, free or connate at the base, 1-celled. Ovules inserted on the adaxial side, mostly many, biseriate, rarely solitary or few. Styles as many as carpels, free, linear or subulate, short to long. *Fruit* follicular, membranous or leathery, opening on the adaxial side. Seeds minute, endosperm usually fleshy; embryo straight.

Distr. About 20 genera and upwards of 700 *spp.*, in the frigid, temperate and warm regions of Europe, Asia, Africa, northern and tropical America, rare in S. America and Australia, absent from Polynesia.

Ecol. Mainly plants of sandy, stony, rocky, sunny localities.

Uses. Some species are used for medicinal purposes, many are cultivated as ornamentals.

### KEY TO THE GENERA

- |  |                     |
|--|---------------------|
| 1. Petals free or very shortly connate . . . . .                     | 1. <b>Sedum</b>     |
| 1. Petals united more than halfway up into a distinct tube . . . . . | 2. <b>Kalanchoë</b> |

### 1. SEDUM

LINNÉ, Sp. Pl. 1 (1753) 430; Gen. Pl. ed. 5 (1754) no 513.

Annual or perennial, erect, ascending or prostrate, sometimes caespitose or muscoid, fleshy herbs, rarely undershrubs, glabrous or glandular pubescent. *Leaves* very variable, alternate, opposite or verticillate, entire or serrate, rarely lacinate, flat or subterete, often spurred at the back of the base. *Flowers* usually in terminal cymes, rarely spicate or solitary in leaf-axils, ♀ or by abortion unisexual. Sepals 4-5, free or almost so. Petals as many, rarely 6-7, free, yellow, white or purple. Stamens as many as petals or usually twice their number, perigynous; epipetalous ones often adnate at the base to the base of the petals. Filaments filiform or subulate; anthers short, 2-lobed. Hypogynous scales entire or emarginate. Carpels 4-5, free or connate at the base, each narrowed into a longer or shorter style. Styles stigmatose on the inner side of the apex. Ovules usually several, rarely solitary or few. *Follicles* 4-5, free, erect or spreading, 1-∞-seeded.

Distr. Species upwards of 350, mainly in the temperate and frigid zones of the N. hemisphere, a few in the S. hemisphere, absent from S. America S of Peru, Antarctica and Australia, in the tropics restricted to the mountains, also in Formosa. In *Malaysia* only one species in Luzon.

Ecol. Most species prefer sandy or rocky places. Many are cultivated as ornamentals.

1. *Sedum ambiflorum* R. E. CLAUSEN, Cact. & Succ. J. 18 (1946) 58.—*S. australe* MERR. Gov. Lab. Publ. 29 (1905) 16, non ROSE (1903); Philip. J.Sc. 5 (1910) Bot. 350; En. Philip. 2 (1923) 217; STEEN. Bull. J.B.B. III, 13 (1934) 195.

Succulent, entirely glabrous, probably perennial herb, 8-15 cm high, with a not very strong, creeping rootstock. Stems arising at intervals from the rootstock, erect or suberect, thin or thickish, simple or sparingly branched. Roots thin. *Leaves*

rather crowded, alternate, sessile, oblong-obovate-spathulate, flat, obtuse, quite entire, fleshy, at the back of the base produced into a downward pointing, short, broad, obtuse spur, 5–20 by 3–6 mm. Cymes rather small, 3- to many-flowered, rather dense. *Flowers* sessile, sometimes with 1 or more leaves at the base. Calyx 3–4 mm long, 5-fid to quite near the base; segments distinctly unequal, rather narrow, slightly tapering towards the very obtuse, thickened apex, marked with many short, in sicco purplish streaks. *Petals* 5, free, bright yellow, elongate-ovate, very acute, 5–7 mm long. Stamens 10; filaments rather long but distinctly shorter than the corolla; epipetalous ones with their base adnate to the base of the petals. Hypogynous scales small, subcuneate, slightly emargin-

ate. Carpels 5, shortly connate at the base. Styles  $\pm 2$  mm. *Follicles* widely spreading, ovoid, acuminate, gibbous at the base of their inner sides, crowned by the recurved styles,  $\pm 5$  mm long. Seeds (not seen) in each carpel 15 or fewer, oblong-cylindrical, shortly apiculate, minutely puncticulate throughout,  $\pm \frac{3}{4}$  by  $\frac{1}{3}$  mm.

Distr. *Malaysia*: Philippines (Luzon).

Ecol. Boulders, crags, rock-crevices, 1200–2500 m.

Note. In the latest monograph of the genus by FRÖDERSTRÖM (Acta Hort. Göteborg. 10, 1935, App. 239) this species is tentatively reduced to *S. aizoon* L., which differs by *unspurred*, usually dentate leaves and larger dimensions. *S. aizoon* L. occurs in Siberia, China, and Japan.

## 2. KALANCHOË

ADANS. Fam. 2 (1763) 248 (*Calanchoë* AUCT.).—*Bryophyllum* SALISB. Parad. Lond. (1805) t. 3.

Erect or ascending, very succulent, herbaceous perennials, rarely woody up to 6 m. *Leaves* either simple and then entire or more or less deeply incised (often spuriously pinnate) or trifoliolate or pinnately 5-foliolate. *Flowers* terminal in corymbose or paniculate cymes, pedicelled. Calyx more or less deeply 4-lobed or 4-fid. Corolla distinctly gamophyllous, 4-lobed less than halfway down; segments patent or recurved. Stamens 8, inserted on the corolla-tube, 2-seriate. Hypogynous scales 4. Ovaries 4, in the Malaysian species erect, free or slightly connate at the base, each narrowed into an erect longish filiform style, many-ovuled. *Follicles* 4, enclosed by the withered calyx and corolla. Seeds  $\infty$  (often not developing in Malaysia).

Distr. Species  $\pm 60$  or more acc. to BERGER (in E. & P. ed. 2, 18a, 1930, 404), centering in Madagascar! and Africa, few *spp.* in Asia, one probably native in the drier parts of *Malaysia*, two introduced from tropical Africa and naturalized, sometimes on a large scale, and one exclusively (and rarely) cultivated.

Ecol. Mainly inhabitants of dry rocky or sandy, sunny or slightly shaded localities.

Uses. Sometimes cultivated for medicinal or ornamental purposes.

Notes. See for chromosome numbers BALDWIN, Am. J. Bot. 25 (1938) 572–579.

### KEY TO THE SPECIES

1. Flowers pendulous. Pedicels  $\frac{3}{4}$ –2½ cm. Calyx divided much less than halfway down, 1½–4 cm long. Corolla-segments red; tube much constricted above the longitudinally furrowed base, widened above the constriction. Stamens inserted far beneath the middle of the corolla-tube at the apex of the basal widening. Hypogynous scales broadly ovate or subrectangular. Styles longer than the ovaries. Detached leaves producing young plants from the crenatures of their margins and sometimes also from the midrib.
2. Calyx terete, 2½–4 cm long. Corolla totalling 3–5½ cm, its base with 8 deep folds; segments ovate-lanceolate, caudately acuminate, 1¼–1¾ cm long. Stem under the inflorescence subterete or obtusely quadrangular. Leaves simple or 3- or 5-foliolate . . . . . 1. *K. pinnata*
2. Calyx quadrangular, 1½–2 cm long. Corolla totalling 2–2½ cm, its base not deeply folded; segments shortly acuminate, 3–5 mm long. Upper part of the stem immediately under the inflorescence acutely quadrangular. Larger leaves deeply pinnately 5–11-fid . . . . . 2. *K. prolifera*
1. Flowers erect or erecto-patent. Pedicels 4–10 mm. Calyx divided almost to the very base, 4–12 mm long. Corolla-segments yellow or orange-yellow; tube lageniform, quadrangular, 1–2 cm long. Stamens inserted in the upper half of the corolla-tube. Hypogynous scales narrowly linear-subulate. Styles shorter than the ovaries. Stem terete or obtusely quadrangular. Detached leaves not producing plants from their margin, neither from the midrib.
3. Larger leaves deeply pinnatifid or bipinnatifid, with narrow segments . . . . . 3. *K. laciniata*
3. Leaves crenate-serrate-biserrate, not deeply incised . . . . . 4. *K. integra*

1. *Kalanchoë pinnata* (LAMK) PERS. Syn. (1805) 446; BL. Bijdr. (1826) 1138; MIQ. Fl. Ind. Bat. 1, 1 (1856) 728; Sum. (1860) 134; HAMET, Bull. Herb. Boiss. II, 8 (1908) 21; BACKER, Schoolfl. (1911) 473; KOORD. Bull. J.B.B. III, 1 (1919) 171; HEYNE, Nutt. Pl. (1927) 687; PERR. DE LA BÂTH. Arch. Bot. 2 (1928) 20; BACKER, Bekn. Fl. Java, em. ed. 4 (1942), fam. 51, p. 2; STEEN. Fl. Sch. Indon. (1949) 193.—*Cotyledon pinnata* LAMK, Dict. 2 (1786) 141.—*Bryophyllum calycinum* SALISB. Parad. Lond. (1805) t. 3; SIMS, Bot. Mag. 34 (1811) t. 1409; DC. Prod. 3 (1828) 396; CLARKE in HOOK. f. Fl. Brit. Ind. 2 (1878) 413; BAILEY, Queensl. Fl. 2 (1900) 545; MERR. Philip. J.Sc. 3 (1908) Bot. 84; Fl. Manila (1912) 218; KOORD. Exk. Fl. 2 (1912) 299; GAGN. Fl. Gén. I.C. 2 (1920) 698, f. 71; RIDLEY, Fl. Mal. Pen. 1 (1922) 688.—*Cotyledon calycina* ROTH, Nov. Pl. Sp. (1821) 217.—*Cotyledon rhizophylla* ROXB. Fl. Ind. ed. CAREY 2 (1832) 456.—*Cotyledon paniculata* (non LINNÉ f.) BLANCO, Fl. Fil. (1837) 381.—*Bryophyllum germinans* BLANCO, Fl. Fil. ed. 2 (1845) 220; ed. 3, 2 (1878) 47, t. 147.—*Bryophyllum pinnatum* (LAMK) OKEN, Allg. Naturgesch. 3 (1841) 1966; KURZ, J. As. Soc. 40<sup>2</sup> (1876) 309; MERR. Philip. J.Sc. (1910) Bot. 351; Fl. Man. (1912) 218; Interpr. Herb. Amb. (1917) 243; Sp. Blanc. (1918) 161; EA. Born. (1921) 286; EN. Philip. 2 (1923) 217; BURK. Ec. Prod. (1935) 376.—Fig. 1.

Robust, unbranched herb, 0.3–2 m high, glabrous (barring outside of corolla-base; see beneath), in the basal part often somewhat woody, ascending from a rooting base or often quite erect; younger part of stem with swollen nodes, green with dark purple blotches. Adult plants leafy only in the upper half or, during anthesis, almost or quite leafless. Pairs of leaves in young plants rather crowded, in old ones remote; lowest leaves not deeply divided, middlemost ones of robust plants often palmately trifoliate, less often pinnately 5-foliate. Leaves or leaflets oval-oblong (the lateral ones from an oblique base), obtuse, crenate or doubly crenate, 5–20 by  $2\frac{1}{2}$ –5 cm; highest floral leaves small, simple, narrow; all leaves thickly fleshy, bordered with purple. Petiole semi-amplexicaulous with a much broadened base,  $1\frac{1}{2}$ –10 cm long; lateral petiolules short. Cymes paniced; panicles much varying in size, 10–80 cm long, rather lax; cymes often many-flowered, their peduncles erectopatent, patent or ascending, 3–8 cm. Calyx terete from a rounded, in the centre slightly intruded base, green, strongly tinged with purple; segments ovate-triangular, very acutely acuminate,  $\frac{3}{4}$ – $1\frac{1}{4}$  cm long, somewhat less wide. Corolla in lower half green, in upper half (especially the exerted part) red; tube much constricted above the ellipsoid or subglobose,  $1\frac{1}{4}$  cm long, strongly 8-folded base, which bears on the outside, especially in the lowest part, numerous short, thickish glandular hairs; folds much prominent, alternately narrow and placed opposite the corolla-segments, and wide and alternating with these; constricted part short, narrow, quadrangular, gradually passing into the much widened, slightly ventricose, obtusely quadrangular upper part; segments recurved. Fila-

ments green at base, pinkish upward, up to  $3\frac{1}{2}$  cm long, slightly exerted. Hypogynous scales adhering at the base to the bases of the ovaries, subrectangular, yellow,  $2\frac{1}{2}$  by  $1\frac{3}{4}$ –2 mm. Ovaries ovoid-oblong, free or connate at the very base, green, glabrous,  $\frac{3}{4}$ –1 cm long, narrowed into

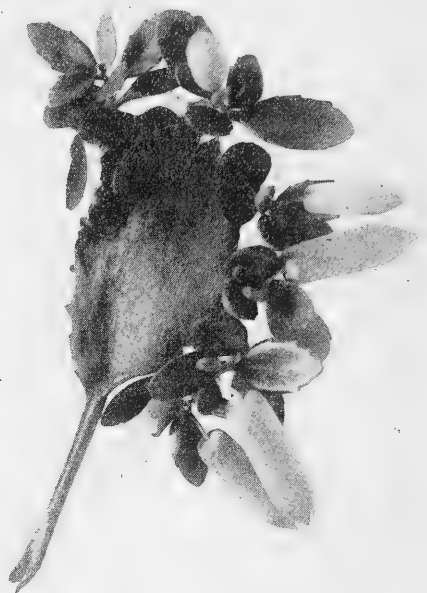


Fig. 1. *Kalanchoë pinnata* (LAMK) PERS. with 1-flowered plantlets on a leaf which was still attached to the plant (v. D. MEER MOHR).

the styles  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long. Seeds (not seen) ellipsoid-oblong, obscurely longitudinally striate.

Distr. Supposed to have originated from trop. Africa, the centre of the genus, but since long carried over to other countries, at present pantropical. Introduced into *Malaysia* very long ago, at present throughout the Archipelago.

Ecol. From the plains up to  $\pm 1000$  m, in sunny or slightly shaded places, either stony or not, but always dry and never very far from human habitations, locally often gregarious. Not rarely cultivated, either as a medicinal plant or for its curious habit of producing single young plants from the crenatures of the leaves either still attached to the plant, or, more often, cut off and hung in a shaded spot on a wall.

Uses. Pounded leaves are used for headache and for poulticing, also as a remedy for fever. In N. Sumatra the plant is used in rice-ceremonies.

Vern. *Wonderblad* (= miracle leaf), D, *life-plant*, E, *buntiris*, S, *tjotjor bèbèk* (with many variants), M, *sosor bèbèk*, J; local names: *gegamed* (Gajo), *dingin dingin*, *kapal kapal* (Batak), *kunambol* (Minahassa), *buntiris keneng*, S, *daun tumbu*



daun (Banka), didindin banen (Atjeh), daun sědjuk, M, sěpohori (Palemb.), tjěkěr bėbėk, tj. itik, M, djampė, djukut kawasa, těrė, S, suru bėbėk, sosor bėbėk, těrė, tudju dėngėn, J, daun antjar bėbėk, d. ghamėt, djampė, tjobbėbė, tjobtjob bhibhik, tj. ėtėk, tombu daun, Md, kadju tēmor (Kangean), mamala (Halmah.), raoe kufiri (Ternate), kabi kabi (Tidore); Philippines: abisrāna (Ilk.), angėlica (Sp.), aritana (Bik.), balangbāng (If.), iŋgiŋga (Ig.), kapal kapal (Sul.), karitana (Bis.), katakatakā (Tag.), kokung (Bon.), lapak lapak (Sul.), putpūtok (Bon.), siem-previva (Sp.). Mal. Peninsula: sėdingin, sėringin, kėrenchong, sėtawar padang, tumbuh daun, ganti batang, rajah bangun.

Note. The young plants developing on the leaves fall off after having produced some roots and a thin stem bearing a few small leaves. They may be transported by rain-wash. In Malaysia the plant never fruits.

A precocious flowering of marginal plantlets was observed by FORBES in Java (Natur. Wand. 1885, 82) later affirmed on specimens from NE. Sumatra by J. KUYPER (Trop. Natuur 20, 1931, 96, fig.): each plantlet had 5–7 leaves and a terminal flower. Specimens of this peculiar race were cultivated at Bogor for some years by Dr F. W. WENT (fig. 1).

**2. Kalanchoë prolifera** (BOWIE) HAMET, Bull. Herb. Boiss. II, 8 (1908) 19; KOORD. Bull. J.B.B. III, 1 (1919) 172; BACKER, Bekn. Fl. Java, em. ed. 4 (1942) fam. 51, p. 3.—*Bryophyllum proliferum* BOWIE msc. in CURT. Bot. Mag. III, 15 (1859) t. 5147; Fl. des Serres 23 (1880) 209.

Robust, erect, quite glabrous,  $\frac{1}{2}$ –2 m high. Lowest leaves and topmost ones of flowering specimens not deeply divided; middle ones profoundly pinnatisect, spuriously odd-pinnate, with 2–5 pairs of lateral segments and an odd one; segments oblong, slightly or rather deeply crenate, green, usually with purple borders, very fleshy, 5–22½ by 2–8 cm; petiole robust, semi-amplexicaulous. Panicle terminal, erect, 50–80 cm long, many-flowered; rachises of inflorescence obtusely quadrangular or subterete. Calyx segments broad, cuspidate. Corolla 2–2½ cm long, distinctly constricted above the subglobose, not deeply furrowed base, widened above the constriction, shortly 4-lobed; segments ovate, shortly acuminate, red, 3–5 mm long. Filaments slightly exerted from the corolla-tube. Hypogynous scales broadly ovate with a rounded apex, slightly broader than long, 1½–2 mm long. Ovaries appressed against each other. Fruit?

Distr. Native of Madagascar, in Malaysia introduced into Java long ago (date unknown; collected there for the first time in Febr. 1894); at present copiously naturalized in some mountainous districts of the western part.

Ecol. Hedges, thickets, road-sides between 1000 and 1600 m, locally numerous and sometimes gregarious, but, on the whole rare. Fl. never in the lower regions and rarely (March–Aug.), but sometimes profusely, in the mountainous zone. Fruits seem never to be produced in Java.

Uses. Sometimes cultivated as a hedge-plant, also at much lower altitudes (down to 150 m).

Vern. Buntiris, S.

Notes. Young plantlets frequently develop at the bases of the pedicels and from the marginal crenations and the midrib of the leaflets (either still attached to the plant or not). A single leaf can give birth to as many as 50 plantlets, which soon fall off and may be distributed by rain-wash.

**3. Kalanchoë laciniata** (LINNÉ) PERS. Syn. (1805) 446; DC. Plant. Hist. Succ. (1799–1829) t. 100; BL. Bijdr. (1826) 1138; DC. Prod. 3 (1828) 395; ROXB. Fl. Ind. ed. CAREY 2 (1832) 456; MOR. Syst. Verz. (1845/46) 39; MIQ. Fl. Ind. Bat. 1, 1 (1856) 728; Sum. (1860) 134; BRITTEN, Fl. Trop. Afr. 2 (1871) 392; NAVES in BLANCO, Fl. Filip. ed. 3 (1878) t. 146; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 415; BACKER, Schoofl. (1911) 473; KOORD. Exk. Fl. 2 (1912) 300; MERR. Fl. Man. (1912) 218; Interpr. Herb. Amb. (1917) 243; Sp. Blanc. (1918) 161; KOORD. Bull. J.B.B. III, 1 (1919) 173; RIDL. Fl. Mal. Pen. 1 (1922) 689; MERR. En. Philip. 2 (1923) 217; HEYNE, Nutt. Pl. (1927) 686; BURK. Ec. Prod. (1935) 1277; BACKER, Bekn. Fl. Java, em. ed. 4 (1942) fam. 51, p. 2.—*Planta anatis* RUMPH. Herb. Amb. 5, 275, t. 95.—*Cotyledon laciniata* LINNÉ, Sp. Pl. (1753) 430; BURM. f. Fl. Ind. (1768) 106.—*Kalanchoë acutiflora* HAW. Syn. Pl. Succ. (1819) 109; DC. Prod. 3 (1828) 395; SPAN. Linnaea 15 (1841) 207.—*Cotyledon lanceolata* BLANCO, Fl. Fil. (1837) 382, non FORSK.—*C. serrata* BLANCO, Fl. Filip. (1837) 382, non L.—*Bryophyllum serratum* BLANCO, Fl. Filip. ed. 2 (1845) 220; ed. 3, 2 (1878) 48.—*Bryophyllum triangulare* BLANCO, Fl. Filip. ed. 2 (1845) 221; ed. 3, 2 (1878) 48.

Erect, rather robust, not or sparingly branched, very fleshy,  $\frac{1}{3}$ –1¼ m high. Stem terete, either glabrous (so in the few Malaysian specimens seen by me) or clothed, as well as the inflorescence, with scattered minute crisped hairs; lower internodes short, intermediate and higher ones gradually longer. Leaves numerous, very variable; the lowest simple, oval, undulate-dentate, shortly petioled or sessile; intermediate ones deeply pinnatifid or bipinnatifid, with narrow, oblong or linear, acute, more or less canaliculate, coarsely dentate-serrate segments, pale glaucous green, ± tinged with purple when young, 8–15 cm long; their petioles 2½–4 cm, fleshy, flattened on the anterior side, with a much broadened, semi-amplexicaul base; upper leaves much smaller, narrow, often entire or almost so. Panicles 10–30 cm long, consisting of many-flowered rather dense cymes, the lower long peduncled; bracts linear, plano-convex, small. Calyx green, variable as to size, 4–10 mm long, glabrous or pubescent, segments erect or erecto-patent, ovate-lanceolate, tapering towards the acute apex. Corolla salver-shaped; tube very distinctly widened downwards, ± 1¼ cm long, green at the base, yellowish upwards; segments 4, widely patent, bright yellow, oval or oval-oblong, glabrous (Malaysian specimens) or pubescent, acute, ± 1 cm long. Anthers slightly exerted. Hypogynous scales entire, 3–3½ mm long. Ovaries lanceolate, glabrous,



Fig. 2. *Kalanchoë integra* O.K. after a specimen from Mt Jang, E. Java, nat. size.

green, 5–6 mm long. Styles glabrous, 2–4 mm. Follicles not seen.

Distr. Hindustan, Bengal, China, and Burma, in *Malaysia* locally cultivated, not wild.

Ecol. In the lower regions not rarely in gardens, often as a potplant near Chinese habitations.

Note. Detached leaves lack the power of producing young plants. But when a leaf is cut off with part of a stem there may arise a new plantlet from the axil.

4. *Kalanchoë integra* (MEDIK.) O.K. Rev. Gen. 1 (1891) 221.—*Cotyledon integra* MEDIK. Acta Acad. Theod. Palat. 3 (1775) 200, t. 9.—*Cotyledon crenata* VENT. Jard. Malm. (1803) t. 49; SIMS, Bot. Mag. (1811) t. 1436.—*Kalanchoë spathulata* DC. Pl. Hist. Succ. (1811) t. 65; PERS. Syn. (1805) 446; BL. Bijdr. (1826) 1138; DC. Prod. 3 (1828) 395; MIQ. Fl. Ind. Bat. 1, 1 (1856) 728; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 414; KOORD. Exk. Fl. 2 (1912) 299; Bull. J.B.B. III, 1 (1918) 174; GAGN. Fl. Gén. I.C. 2 (1920) 701; BURK. Dict. (1935) 1277; BACKER, Bekn. Fl. Java, em. ed. 4, (1942) fam. 51, p. 2.—*Kalanchoë crenata* HAW. (non HAMET) Syn. pl. Succ. (1812) 109; BRITTEN, Fl. Trop. Afr. 2 (1871) 394.—*Kalanchoë acutiflora* HAW. Syn. Pl. Succ. (1812) 109; DC. Prod. 3 (1828) 395; MIQ. Fl. Ind. Bat. 1, 1 (1856) 728.—*Cotyledon spathulata* POIR. in LAMK, Enc. Suppl. 2 (1811) 373.—*Kalanchoë brasiliensis* CAMB. in A. ST. HIL. Fl. Bras. Merid. 2 (1829) 196; KOORD. Bull. J.B.B. III, 1 (1919) 173.—*Kalanchoë laciniata* DC. ex parte sensu HAMET, Bull. Herb. Boiss. II, 7 (1907) 897.—*Kalanchoë schumacheri* KOORD. Bull. J.B.B. III, 1 (1918) 180, t. 14, 15.—*K. sp.* BACKER, Bull. J.B.B. II, 12 (1913) 20.—Fig. 2.

Erect or ascending, rather robust, usually unbranched, fleshy,  $\frac{1}{3}$ – $1\frac{3}{4}$  m high, with a strong taproot. Stem terete or obtusely quadrangular, glabrous throughout or in the upper part beset with short, glandular hairs; old stems fistular; lower internodes short, highest much longer. Leaves (often falling off in or before beginning of the anthesis) oval-oblong-obovate-lanceolate-spathulate from a more or less cuneate base, or the upper lanceolate-linear, obtuse, lightgreen, glaucous or more or less tinged with purple, rather shortly to rather long petioled (lower), shallowly or coarsely crenate-serrate-dentate-biserrate, or the upper entire or almost so and sessile or subsessile, thickly coriaceous, glabrous (Malaysian specimens) or glandular pubescent, 4–30 by  $2\frac{1}{2}$ – $12\frac{1}{2}$  cm; petiole with a much broadened, semi-amplexicaulous base. Cymes subcorymbose or, in well-developed speci-

mens, united into a long peduncled, rather wide and comparatively short panicle, many-flowered, rather dense; the lower on long erecto-patent peduncles. Rachises of inflorescence glabrous (so in *Malaysia*) or glandular pubescent. Pedicels 4–8 mm, glabrous or glandular pubescent. Calyx 4–12 mm long; segments erect or erecto-patent, elongate-triangular, acute, glabrous or shortly ciliate or on the outside glandular pubescent. Corolla variable as to size, above the greenish base yellow or orange-yellow; tube in the lower half distinctly ventricose (especially when fruiting), much contracted upwards. Segments patent or subreflexed, after anthesis erect and twisted together, oval-elliptic-obovate with a recurved short apical point,  $\frac{3}{4}$ – $1\frac{1}{4}$  cm long, glabrous or ciliate or on the outside glandular pubescent. Filaments short, glabrous; anthers either all included or those of the upper series slightly exerted. Hypogynous scales entire,  $3\frac{1}{2}$ –5 mm long. Ovaries free or subconnate at the base, appressed against each other, glabrous,  $\frac{1}{2}$ –1 cm long. Styles included, filiform, glabrous. Follicles ovoid-oblong, acuminate by the style-bases, in their upper halves slightly recurved when fully ripe,  $1$ – $1\frac{1}{4}$  cm long.

Distr. Brazil, tropical and South Africa, S. and SE. Asia, in *Malaysia*: Java, Madura, Lombok, Celebes, Philippines.

Ecol. From the plains up to  $\pm$  2000 m, in sunny, stony or rocky places, frequently on almost bare rocks (e.g. of lava-streams), and in light *Casuarina* forest, locally often abundant. Flowers and fruits freely; very conspicuous when in full flower. In Java the distribution of the species is remarkable; the localities are confined to East Java (E of Malang) save some very local spots in Krawang on old-volcanic peaks. In East Java the localities are mostly situated on the eastern (hottest and driest) slopes of the mountains.

Uses. Ornamental.

Vern. *Buntiris*, S, *kayu urip*, J, *tampu taura* (S. Celebes).

Notes. Variable. Many forms differing only in characters of very slight taxonomic value have been described as species. They all pass into each other. HAMET (*l.c.*) regards this species as a form of *K. laciniata* in which he may be right. I have provisionally kept it apart because in *Malaysia* no transitional forms have been found. Separated leaves lack the power of producing new plants, but when a leaf is cut off with a bit of the stem, there arise from the axil first some roots, afterwards a leafy stem.

## ELATINACEAE (C. A. Backer, Heemstede)

Annual herbs. *Leaves* stipulate, opposite or verticillate, simple. *Flowers* axillary, solitary, glomerate or fascicled, actinomorphic, ♂, small or minute; *sepals* 2–5, free or shortly connate, imbricate in bud, pellucid or with pellucid margins, 1-nerved or nerveless, persistent. *Petals* the same number as sepals, not or slightly surpassing them, imbricate in bud, free, membranous, persistent. Disk absent. Stamens as many as petals (and alternating with them) or more, but not more than twice their number, persistent; anthers dorsifixed, small, 2-celled; cells bursting longitudinally. Ovary superior, 2–5-celled, isomerous (except in *Bergia trimera*); cells ∞-ovuled. Ovules in the inner angles of the cells. Styles equal in number to the cells, free, short, persistent. *Capsule* small, septicidally dehiscent. Seeds many, minute, oblong, straight or curved, in transverse section terete; embryo straight or curved; cotyledons short; no endosperm.

**Distr.** Genera 2, in the temperate and tropical zones of both hemispheres, both of them in *Malaysia*. **Ecol.** Inhabitants of permanently or seasonally swampy or inundated localities. In some extra-Malaysian *spp.* the leaves are heteromorphous, the submerged ones being much divided. Vegetatively several *Elatinaceae* are rather plastic as is the case with many other waterplants, e.g. *Callitrichaceae*. In some *Elatinaceae* flowers are not rarely cleistogamous, cf. *E. triandra* (cf. NIEDENZU, E. & P. ed. 2, 21, 1925, 272).

**Vern.** No reliable names.

**Note.** At first sight *Elatinaceae* might be confused with representatives of some other families with opposite leaves and minute axillary flowers. Easily perceptible differentiating characters against *Callitrichaceae* and *Aizoaceae* are the presence of a calyx and corolla, *Halorrhagaceae*, *Nyctaginaceae* and *Rubiaceae* the superior ovary, *Scrophulariaceae* the free corolla segments, *Lythraceae* the free calyx lobes, *Amaranthaceae* the at least 2-celled ovary, and *Urticaceae* bisexual flowers and alternipetalous stamens.

### KEY TO THE GENERA

1. Flowers (in the Malaysian species) glomerate or fascicled, 5-merous. Sepals acute, with a strongish midrib . . . . . **1. *Bergia***
1. Flowers (in the Malaysian species) solitary, 3-merous. Sepals obtuse, nerveless. Very small plants. . . . . **2. *Elatine***

### 1. BERGIA

LINNÉ, Mant. 2 (1771) 152, no 1309.

Annual herbs, erect, ascending or decumbent. *Leaves* opposite, shortly petioled, finely serrate. Stipules persistent. *Flowers* (in the Malaysian species) fascicled or glomerate, 5-merous. Sepals free, acutely acuminate, keeled by the strongish midrib, with broad pellucid nerveless margins. Petals oval-oblong, thinly membranous. Stamens the same number as petals or more, but not more than 10. Ovary and *capsule* globose or ovoid, 5-celled; stigmas capitate. Seeds oblong, with rounded ends, faintly curved, with a faint or strong, scalariform reticulation.

**Distr.** Species ± 20; in *Malaysia* 2, inhabitants of the lower regions, mostly in anthropogenic localities.

### KEY TO THE SPECIES

1. Entire plant glabrous; stems thick, succulent, not fistular but divided by radiating septa into a peripheric whorl of rather wide air-vessels. Pedicels  $\frac{1}{2}$ –3 mm long. Sepals  $1\frac{1}{2}$ –2 mm long. Petals slightly exceeding the sepals. Stamens 10. Seeds strongly reticulated . . . . . **1. *B. capensis***
1. Stems glandular-pubescent, hard, not succulent, fistular but not divided by radiating septa into a whorl of air-chambers. Leaves glandular-pubescent beneath. Pedicels glandular-pubescent, 2–22 mm long. Sepals glandular-pubescent, 3–4 mm long. Petals slightly shorter than the sepals. Stamens in the Malaysian specimens 5–10. Seeds very faintly reticulated . . . . . **2. *B. ammannioides***

**1. *Bergia capensis*** LINNÉ, Mant. 2 (1771) 241; COOKE, Fl. Bomb. 1 (1901) 74; BACK, Onkr. Suiker. (1930) 453, t. 427; Bekn. Fl. Java, em. ed. 4 (1942) fam. 53, p. 1; D'ALMEIDA, J. Bomb. Nat. Hist. Soc.

43 (1943) 93, pl. 1–3; MILNE-REDHEAD, Kew Bull. 1948, 450 (1949).—*B. verticillata* WILLD. in LINNÉ, Sp. Pl. ed. 4, 2 (1799) 770, nom. illegit.; ROXB. Fl. Ind. 2 (1832) 456; DALZ. & GIBS. Bomb.



Fig 1. *Bergia capensis* L. Habit,  $\times \frac{1}{2}$ . Courtesy Pasuruan Exp. Station.

Fl. (1861) 14; OLIVER, Fl. Trop. Afr. 1 (1868) 152; TH. DYER in HOOK. f. Fl. Br. Ind. 1 (1874) 252; TRIMEN, Fl. Ceyl. 1 (1893) 92; BACK. Voorl. Schoolfl. (1908) 19; Schoolfl. (1911) 86; KOORD. Exk. Fl. 2 (1912) 623.—*B. aquatica* ROXB. Corom. Pl. 2 (1798) 22, t. 142, *nom. illegit.*—*B. repens* BL. Bijdr. (1825) 62.—*Elatine verticillata* W. & A. Prod. (1834) 41.—Fig. 1.

Herb with a creeping, 8–50 cm long main stem and ascending branches; stems terete, red or pink, faintly shining. Stipules erect, ovate-triangular, long-acuminate, acute, dentate, membranous, 2–3 mm long. Leaves subsessile, oblong-lanceolate or lanceolate, from an acute base, acute, finely serrulate, with red teeth,  $1\frac{1}{2}$ –5 by  $\frac{3}{4}$ – $2\frac{1}{2}$  cm; petiole 1–5 mm. Flowers in many-flowered, dense clusters, 5-merous. Sepals erect, broadly elliptic, shortly acuminate, acute, light green, tipped with red,  $1\frac{1}{2}$ –2 mm long. Petals at first erect, afterwards widely patent or recurved, oblong or subspatulate, white, transparent. Filaments thin, filiform from a slightly broadened base. Ovary subglobose; styles erect-recurved,  $\frac{1}{4}$ – $\frac{1}{3}$  mm long. Capsule subglobose, with 5 longitudinal furrows,  $\pm 2\frac{1}{2}$  mm diam. Seeds slightly less than  $\frac{1}{2}$  mm long.

Distr. Hindustan, Ceylon, in *Malaysia*: Java.

Ecol. Inhabitant of swampy localities: muddy paddy-fields, humid grassland, shallow pools, riverbanks. Fl. (in Java) Febr.–June.

2. *Bergia ammann(ioides)* ROXB. (Hort. Beng. 1814, 34, *nomen nudum*) ex ROTH, Nov. Pl. Sp. (1821) 219; DC. Prod. 1 (1824) 390; ROXB. Fl. Ind. 2 (1832) 457; DALZ. & GIBS. Bomb. Fl. (1861) 14; BTH. Fl. Austr. 1 (1863) 180; OLIV. Fl. Trop. Afr. 1 (1868) 132; DYER in HOOK. f. Fl. Br. Ind. 1 (1874) 251; TRIMEN, Fl. Ceyl. 1 (1893) 92; BAILEY, Queensl. Fl. 1 (1899) 100; COOKE, Fl. Bomb. 1 (1901) 73; BACK. Fl. Bat. 1 (1907) 82 (*excl. syn. B. repens* BL.); Voorl. Schoolfl. (1908) 19; Schoolfl. (1911) 86; KOORD. Exk. Fl. 2 (1912) 623; MERR. Sp. Blanc. (1918) 273; En. Philip. 3 (1923) 103.—*Elatine ammann(ioides)* W. & A. Prod. (1834) 41; SPAN. Linnaea 15 (1841) 167 (*excl. syn. B. repens* BL.); MIQ. Fl. Ind. Bat. 1, 2 (1859) 119 (*excl. syn. B. repens* BL.); BRITTEN in FORB. Nat. Wand. (1885) 500.—*Tillaea rubella* BLANCO, Fl. Filip. (1837) 75, ed. 2 (1845) 56, ed. 3, 1 (1877) 106.—*Bergia serrata* BLANCO, Fl. Fil. (1837) 273; MERR. Philip. J. Sc. 2 (1907) Bot. 431; Fl. Manila (1912) 333; Sp. Blanc. (1918) 273; En. Philip. 3 (1923) 103.—*Spergula serrata* BLANCO,

Fl. Fil. ed. 2 (1845) 271; ed. 3, 2 (1878) 140.—*Bergia glandulosa* TURCZ. Bull. Soc. Nat. Moscou 27:2 (1854) 371; ROLFE, J. Bot. 23 (1885) 210.—*Bergia oryzetorum* FENZL in ZOLL. Syst. Verz. Heft 3 (1855) 62; BACK. Onkr. Suiker. (1930) 453, t. 428; Bekn. Fl. Java, em. ed. 4 (1942) fam. 53, p. 1.

Annual, often branched from the base, erect, ascending or decumbent and then with erect, suberect or ascending branches, frequently somewhat woody at the base, 8–50 cm long; stems terete. Stipules erect, narrowly triangular, very acute, along the margins and on the back of the midrib rather thinly beset with short or rather longish glandular or subglandular hairs, membranous,  $2\frac{1}{2}$ –5 mm long. Leaves elliptic-oblong, oblong or obovate-oblong, from an acute or contracted base, acute, very shortly dentate-serrate and remotely gland-ciliate, sparingly finely hairy or glabrous above, 10–40 by 2–15 mm; petiole 2–5 mm. Flowers in few- to many-flowered fascicles. Pedicels thin, very variable as to length, usually 2–12 mm, sometimes up to 22 mm long. Sepals in *Malaysia* always 5 (in *Hindustan* and *Ceylon* usually 3), ovate-oblong, rather long- and narrowly acuminate, concave, keeled by the strong green midrib, otherwise thinly membranous and transparent, shortly ciliate, 3–4 mm long. Petals the same number as sepals, slightly shorter than these, oval-oblong, obtuse, thinly membranous, white,  $2\frac{1}{2}$ –3 by 1– $1\frac{1}{4}$  mm. Stamens usually as many as sepals (in *Java* always so), narrowly subulate (in the *Philippine* specimens often 7–10) and the supernumerary of these then much narrower than the others, subfiliform (in dried materials often difficult to observe), rather long. Ovary ovoid. Styles in *Malaysia* 5, erect-recurved,  $\pm \frac{1}{2}$  mm long (thick stigmas included). Capsule ovoid,  $\pm 2$  mm long. Seeds numerous, with a faintly prominent reticulation, light brown,  $\pm \frac{1}{3}$  mm long.

Distr. Tropical Africa, Afghanistan, Persia, tropical Asia and Ceylon to S. China, Formosa and Australia, in *Malaysia*: Java, Madura, Timor, Philippines (Luzon).

Ecol. Dry regions, from the plains up to  $\pm 100$  m above sea-level, in seasonally inundated and again dried out localities, especially in fallow paddy-fields, also on road-sides and railway-embankments, locally often very numerous.

Note. Philippine specimens with long pedicels and some supernumerary stamens have been described as *Bergia serrata* BLANCO. They strikingly resemble typical plants.

## 2. ELATINE

LINNÉ, Sp. Pl. (1753) 367; Gen. Pl. ed. 5 (1754) no 451.

Small glabrous herbs of swampy, muddy or inundated localities. Leaves in the *Malaysian* species opposite, shortly stalked. Flowers solitary, minute, 2–4-merous. Sepals shortly connate at the base, obtuse, nerveless. Petals exceeding the sepals, broadly oval, white or pink. Stamens as many as petals or twice their number. Ovary globose. Fruit globose with an impressed apex and a very thin transparent wall. Seeds numerous, straight or curved, with a scalariform reticulation.

Distr. Species  $\pm$  12, throughout the area of the family.

Note. The small size and habitat of *Elatine* are probably the major causes for its scarcity in the herbaria. A special search would doubtless reveal many additional localities outside Sumatra and Java; the late Dr P. J. EYMA collected a specimen near the Wissel Lakes, SW. New Guinea (EYMA 4455) at ca 1700 m alt., but unfortunately the material at hand does not permit critical naming.

#### KEY TO THE SPECIES

1. Flowers sessile or obscurely pedicelled, often not expanding. Stamens in expanded flowers longer than the sepals. . . . . **E. triandra**
1. Flowers on pedicels  $1/2$ – $1\frac{1}{2}$  mm long, expanding. Stamens shorter than the sepals. . . . . **E. ambigua**

**1. *Elatine triandra*** SCHUHR, Bot. Handb. 1 (1808) 345, fig. 109 b, f. 2, *sensu lato*.—*Peplis americana* PURSH, Fl. Am. Sept. 1 (1814) 238.—*E. americana* ARN. Edinb. Journ. Nat. & Geogr. Sc. 1 (1830) 431; BTH. Fl. Austr. 1 (1863) 178; DYER in HOOK. f. Fl. Br. Ind. 1 (1874) 251; BAILEY, Queensl. Fl. 1 (1899) 99; BACKER, Ann. J.B.B. Suppl. 3 (1909) 401; Schoofl. (1911) 85; KOORD. Exk. Fl. 2 (1912) 623; BACKER, Bekn. Fl. Java, em. ed. 4 (1942) fam. 55, p. 2.

Delicate creeping herb, often much branched and forming dense patches, 1–15 cm long. Stipules minute, ovate-triangular, acutely acuminate, dentate, deciduous. *Leaves* opposite, ovate-oblong-lanceolate-spathulate, decurrent winglike along the petiole, obtuse, rounded or emarginate, entire, penninerved, with or without a row of distant glandlike hydathodes along the margin,  $3\frac{1}{2}$ –15 by  $1\frac{1}{2}$ –4 mm. *Flowers* sessile or obscurely pedicelled in one axil only of a pair of leaves; those of successive pairs alternately on the right and the left side of the stem. Sepals 2–3, half as long as the petals. Petals broadly oval, white or pink,  $1$ – $1\frac{1}{4}$  mm long. Stamens 3, in expanded flowers longer than the sepals. Stigmas 3, almost sessile, punctiform. *Capsule* subglobose,  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm diam. Seeds oblong with rounded ends, faintly curved, yellowish brown,  $\pm \frac{1}{2}$  mm long.

Distr. N. America, Europe, and Hindustan to Australia and New Zealand, in *Malaysia*: N. Sumatra, Java.

Ecol. In Java in the eastern part in shallow

lakes with very limpid water, and on inundated rice-fields, living quite submersed, forming dense patches on the bottom, locally very numerous, 500–2000 m. Many closed flowers seen, not a single expanded one.

Note. FASSETT accepts PURSH's taxon as a *var. americana* (PURSH) FASSETT of *E. triandra* (Rhodora 33, 1931, 72; *ibid.* 41, 1939, 373). FERNALD (*ibid.* 43, 1941, 208 *seq.*) maintains that there is an important difference between *E. triandra* and *E. americana* in the structure of the ovary, *viz* that in the first the seeds are borne the whole length of the central axis and are horizontally divergent, whereas in the latter the seeds are borne at the base of the central axis and stand vertically. The material at hand from Malaysia is insufficient to check this criterion.

**2. *Elatine ambigua*** WIGHT in HOOK. Bot. Misc. 2 (1831) 103, Suppl. t. 5; W. & A. Prod. (1834) 41; DYER in HOOK. f. Fl. Br. Ind. 1 (1874) 251; KOORD. Exk. Fl. 2 (1912) 623; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 55, p. 2.

Leaves  $2\frac{1}{2}$ –5 mm long. Pedicels distinct,  $1/2$ – $1\frac{1}{2}$  mm. Stamens shorter than the sepals. Otherwise quite like the preceding species and probably only a temporarily terrestrial form of it.

Distr. Hindustan, Fiji Islands, and *Malaysia*: Java. In W. Java at 250 m above sea-level in a single specimen, in E. Java at 1900 m in large numbers; in both localities on sandy mudbanks in and along riverbeds.

# HYDROPHYLLACEAE<sup>1</sup> (C. A. Backer, Heemstede)

## 1. HYDROLEA

LINNÉ, Sp. Pl. ed. 2 (1763) 328, *nom. cons.*—*Nama* LINNÉ, Sp. Pl. ed. 1 (1753) 226, *non* L. 1759.—*Beloanthera* HASSK. Flora (Bot. Zeit.) 1842, Beibl. 2, p. 53.

Annual or perennial, unarmed or spinous, bitter herbs or undershrubs, often glandular-hairy. Stem terete, farctate, with a peripheral whorl of air-vessels. *Leaves* spread, simple, entire, exstipulate. *Flowers* ♀, actinomorphic, solitary, opposite or between the leaves, or by stunting of the leaves, more or less arranged in a racemiform or paniculiform inflorescence, distinctly pedicelled, lilac blue. Calyx persistent, 5-partite to near the base, segments lanceolate, imbricate in bud, after anthesis not or hardly accrescent. Corolla gamopetalous, deeply 5-partite; limb rotate; segments imbricate in bud, oval, obtuse. Stamens 5, free, inserted in the throat of the corolla, alternating with the segments; filaments filiform from a broadened base, glabrous or papillate; anthers 2-celled, bifid at the base and apex, opening lengthwise. Disk absent. Ovary superior, 2- (rarely 3-, very rarely more-) celled; placentas adnate to the dissepiment, spongy, entire or in cross-section bifid; styles 2 (rarely 3 or more), free; stigmas capitate-clavate. Ovules ∞. *Capsule* globose or ellipsoid, loculicid, or both loculicid and septicid, 2(rarely more)-valved, or bursting irregularly. Seeds ∞, very small, longitudinally ribbed; endosperm small, straight.

Distr. Species ± 20, in the tropics of both hemispheres; in *Malaysia* 2, of which one indigenous, the other introduced and naturalized in Java.

Ecol. Inhabitants of permanently or intermittently humid or swampy localities at low altitudes, often gregarious. Stem-bases often swollen by spongy aerenchyma.

### KEY TO THE SPECIES

1. Placentas in cross-section entire. Corolla from the base of the tube up to the tips of the segments 4<sup>1</sup>/<sub>2</sub>–7 mm long. Styles 1<sup>1</sup>/<sub>2</sub>–2 mm. Stem unarmed, glabrous or only at the top glandular hairy . . . . .

1. *H. zeylanica*

1. Placentas in cross-section 2-partite. Corolla from the base of the tube up to the tips of the segments 10–12 mm long. Styles 6–8 mm. Stem in the Javan specimens spinous and down to far beneath the top clothed with patent, rather long, gland-tipped very viscid hairs . . . . .

2. *H. spinosa*

1. *Hydrolea zeylanica* (LINNÉ) VAHL, Symb. Bot. 2 (1791) 46; CHOISY, Mém. Soc. Phys. Genève 6 (1833) 107; WIGHT, Ic. Pl. Or. 2 (1843) t. 601; BLANCO, Fl. Fil. ed. 2 (1845) 148; ed. 3, 1 (1877) 266; CHOISY in DC. Prod. 10 (1846) 180; MIQ. Fl. Ind. Bat. 2 (1857) 633; DALZ. & CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 133; MERR. Fl. Man. (1912) 392; KOORD. Exk. Fl. 3 (1912) 125; BRAND, Pfl. R. 59 (1913) 174; MERR. Sp. Blanc. (1918) 326; EN. BORN. Pl. (1921) 510; EN. PHILIP. 3 (1923) 372; RIDL. Fl. Mal. Pen. 2 (1923) 438; BACK. Onkr. Suiker. (1931) 533; OCHSE & BAKH. V. D. BR. Veg. (1931) 349, f. 220; BURK. Dict. 1 (1935) 1213; STEEN. Bull. Bot. Gard. Buit. III, 17 (1948) 460; BACK. Bekn. Fl. Java, em. ed. 8 (1949) fam. 188, p. 3; HENDERSON, Mal. Wild. Fl. 2 (1950) 308, fig. 291.—*Nama zeylanica* LINNÉ, Sp. Pl. (1753) 226; BURM. f. Fl. Ind. (1768) 73; O.K. Rev. Gen. 2 (1891) 435.—

*Steris javanica* LINNÉ, Mant. 1 (1767) 54, 2 (1771) 264.—*Steris aquatica* BURM. f. Fl. Ind. (1768) 73, t. 39, f. 3.—*Hydrolea inermis* LOUR. Fl. Coch. 1 (1790) 172; CHOISY, Mém. Soc. Phys. Genève 6 (1833) 108; DC. Prod. 10 (1846) 180; BACK. Ann. J.B.B. Suppl. 3 (1909) 404.—*Hydrolea javanica* BL. Bijdr. (1826) 725.—*Hydrolea arayatensis* BLANCO, Fl. Fil. (1837) 211.—*Nama jamaicensis* BLANCO, Fl. Fil. (1837) 211; ed. 2 (1845) 148; ed. 3, 1 (1877) 266, *non* L.—*Beloanthera oppositifolia* HASSK. Flora (Bot. Zeit.) 1842, Beibl. 2, 53; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1065.—Fig. 1.

Perennial, 0.10–1.50 m long, often much branched. Stem in the lower part creeping and freely rooting, emitting many erect branches, in the higher part erect. *Leaves* variable as to shape and size, usually narrowly lanceolate, less often oblong or elliptic, from an acute or (broader leaves) slightly

(1) Rather small family consisting of *ca* 18 genera and *ca* 230 *spp.*, mostly American, few in Africa, Asia, and the Sandwich Islands.

Besides *Hydrolea* a few American *spp.* of the genera *Nemophila* and *Wigandia* are sometimes cultivated as ornamentals in Malaysia. Cf. WIGMAN, Teysm. 32 (1921) 49.





Fig. 1. *Hydrolea zeylanica* (L.) VAHL, flowering branch, nat. size, *a*. bud, *b*. flower in anthesis, *c*. ovary, *d*. ovary in section (details enlarged; after WIGHT).

obtuse base, acute, quite glabrous or along the margins shortly and indistinctly ciliolate,  $1\frac{1}{2}$ –12 cm by  $\frac{3}{4}$ – $2\frac{1}{2}$  cm; primary nerves 4–11 pairs. Petiole 2–5 mm, glabrous or, in young leaves, glandular hairy. *Flowers* either solitary opposite or between the leaves or arranged in shorter or longer lax or rather dense racemes or panicles, which are often combined into a leafy paniculiform inflorescence; pedicels patently glandular hairy or glabrous, 2–10 mm. Calyx usually clothed on the outside with patent, gland-tipped hairs, rarely glabrous, during anthesis 5–7 mm long, afterwards slightly accrescent; segments narrowed towards the tip. Corolla tube white, segments lilac blue with a white base, at last widely patent, oval, obtuse,  $2\frac{1}{2}$ –4 mm wide. Filaments  $2\frac{1}{2}$ –4 mm long, white or lilac, glabrous, their broadened base white as are the anthers. Apex of ovary finely pubescent. Styles 2, widely divergent, thinly pilose, lilac blue; stigmas white. *Capsule* ellipsoid, 4–5 mm long, thinly pilose, bursting irregularly. Seeds oblong,  $\frac{1}{3}$ – $\frac{2}{5}$  mm long.

*Distr.* Ceylon, Hindustan, Further India; also reported for Queensland (not seen from there), in *Malaysia*: only in the western half: Simalur, Sumatra, Malay Peninsula, SE. Borneo, Java, SW. Celebes, Philippines.

*Ecol.* From the plains up to  $\pm 1000$  m, in permanently or periodically swampy or inundated localities, very often in paddy-fields, also in shallow pools and on river-banks, locally often so numerous that the flowers tinge the whole field blue. *Fl.* Jan.–Dec. in favourable localities.

*Uses.* Young leafy tops of the stems are eaten. In India the foliage is used as a poultice for ulcers.

*Vern.* Several names, all of them unreliable as they are also applied to other more or less similar plants: *gagàbusan*, *sëmbung*, *djukut saät*, S., *gunda*, J, S, *balihin fonau* (Simalur).

*Note.* Most of the Malaysian specimens have a glandular calyx. In Borneo and Central Java specimens with a glabrous calyx (var. *glabra* BRAND) have been collected.

**2. *Hydrolea spinosa* LINNÉ, Sp. Pl. ed. 2 (1763) 328; GAERTN. Fruct. 1 (1788) 263, t. 55, f. 9; H.B.K. Nov. Gen. 3 (1818) 98; Bot. Reg. 7 (1821) t. 566; CHOISY, Mém. Soc. Phys. Genève 6 (1833) 110; in DC. Prod. 10 (1846) 181; BENN. in MART. Fl. Bras. 7 (1871) 394, t. 129; BACK. Ann. J.B.B. Suppl. 3 (1909) 404; KOORD. Exk. Fl. 3 (1912) 125;**

BRAND, Pfl. R. 59 (1913) 180, f. 39; KAINRADL, Sitz. Ber. Akad. Wiss. Wien, M.-N. Kl. Abt. I, 136 (1927) 167–193; BACK. Onkr. Suiker. (1930) 533; Bekn. Fl. Java, em. ed. 8 (1949) fam 188, p. 3.

var. *spinosa*.—var. *euspinosa* BRAND, l.c. 181.

Perennial, 0.60–1.30 m long, often much branched. Stems rather robust, erect or usually in the lower part creeping, copiously rooting and sending up many erect strong branches; thorns (metamorphosed branches) axillary, patently glandular hairy with a very sharp glabrous apex, often bearing small leaves, at last  $\frac{1}{2}$ –6 cm long; the larger ones not rarely ramified. *Leaves* oblong or lanceolate from an acute base, often slightly undulate, on both surfaces and along the margin thinly glandular pubescent, 1–12 cm by  $\frac{1}{4}$ –3 cm; primary nerves 10–20 pairs. Petiole rather densely glandular pubescent, 2–15 mm. *Flowers* arranged in dense small-leaved racemes or panicles which are combined into a leafy, often dense and rather large paniculiform inflorescence. Pedicels patently glandular hairy,  $1\frac{1}{2}$ –8 mm. Calyx outside densely clothed with long gland-tipped hairs, during anthesis 7–9 mm long, afterwards not or hardly accrescent; segments acute. Corolla tube white at the base, segments a fine lilac blue, at last widely patent, oval, obtuse, 5–8 mm wide. Filaments 8–10 mm, glabrous; their widened base papillate. Ovary on the top clothed with short glandular hairs, otherwise glabrous. Styles 2 or sometimes 3, very rarely more, divergent, violet, glandular-pubescent. *Capsule* broadly ellipsoid, with a glandular pubescent apex, 6–7 mm high, mostly 2-valved. Seeds oblong, longitudinally ribbed, brown,  $\frac{1}{2}$ – $\frac{2}{3}$  mm long.

*Distr.* Native of tropical America, already long ago introduced into *Malaysia*: yet only locally naturalized in the N. part of W. Java.

*Ecol.* Sunny or slightly shaded permanently or periodically humid or swampy localities; pools, irrigation ditches, fallow paddy-fields, usually gregarious, locally often very numerous, 1–250 m. *Fl.* Jan.–Dec.

*Note.* Entire plant intensely bitter.

#### Excluded

*Ellisiophyllum* MAXIM. has sometimes been regarded as hydrophyllaceous, but will in this Flora, and in agreement with many recent authors, be treated in the *Scrophulariaceae*. Cf. also BRAND, Pfl. R. 59 (1913) 185.

## JUNCACEAE<sup>1</sup> (C. A. Backer, Heemstede)

Perennial or annual herbs, tufted or with an erect or creeping rhizome. Stems mostly leafy only at the base but sometimes also in the higher parts. *Leaves* spirally arranged, cylindric to flat and grass-like, mostly linear or filiform, sheathing at the base or entirely reduced to a sheath; sheaths open or closed, sometimes ciliate at the top. *Flowers* mostly protogynous and anemophilous, solitary or in anthelas, panicles, corymbs or heads, usually small, actinomorphic, ♀ or (♂) (♀). Tepals 6, free, in two whorls, rarely only 3, glumaceous or coriaceous, rarely white. Stamens 3–6, when 3 opposite the outer tepals; filaments thin; anthers basifixed, introrse; cells opening longitudinally; pollen in tetrads. Ovary superior, 1-celled or divided by 3 septa into 3 cells; style short to long; stigmas 3, papillose; ovules 3, inserted at the base of the ovary or numerous and biseriate on 3 parietal placentas. *Fruit* a dry, 1- or 3-celled capsule, loculicidally 3-valved. Seeds sometimes tailed; embryo in the middle or at the base of the endosperm, small.

Distr. Genera 8, with 250–300 species, especially in the temperate and cold regions of both hemispheres; in the tropics restricted to the mountainous districts.

Ecol. Mainly herbs of wet or moist habitats above 1000 m, sometimes gregarious.

Uses. In Malaysia unimportant. Some species used for tying parcels, some for medicinal purposes. In Europe *Juncus* is largely used for mats and chair-bottoms.

### KEY TO THE GENERA

1. Fruit many-seeded; placentas parietal. Leaves glabrous, flat to terete . . . . . 1. *Juncus*
1. Fruit 3- or fewer-seeded; placentas basal. Leaves along the margins with long very fine hairs, flat . . . . . 2. *Luzula*

### 1. JUNCUS

LINNÉ, Sp.Pl. (1753) 325; Gen. Pl. ed. 5 (1754) no 396.

Perennial or annual herbs. Stems often tufted, or crowded on a creeping rhizome. *Leaves* either all radical or also higher on the stem, grass-like or terete and stem-like. *Flowers* small, sessile or peduncled in dense or lax cymes. Inflorescence terminal or spuriously lateral and then its bract continuous with the stem. Tepals 6, glumaceous, equal or the 3 inner smaller. Stamens 3–6, attached to the base of the tepals; filaments filiform; anthers erect, oblong or linear. Ovary sessile; placentas 3, parietal, sometimes hardly prominent, more frequently protruding and sometimes connate in the middle; ovules many in each cell; style short or longish; stigmas 3, linear, often twisted. *Capsule* 3-valved; valves usually bearing the placentas in their middle; rarely the 3 placentas becoming detached and remaining free or cohering into a central column. Seeds minute, ovoid or oblong, very faintly ribbed; embryo small, near the hilum.

Distr. Species  $\pm$  200, largely spread over both hemispheres, most abundant in the cool and temperate zones, but also occurring in the mountainous districts of the tropics, usually in moist or marshy localities.

### KEY TO THE SPECIES

1. Inflorescence on each flowering stem a solitary, pseudo-lateral, many-flowered cyme; its single bract terete, continuous with the terete or subterete stem and resembling it. Flowers with 2 minute, membranous basal bracteoles. Stems erect, close-set in a row on a creeping rhizome.
2. Perianth 2–2 $\frac{3}{4}$  mm long, pale green or yellowish. Stamens usually 3. Capsule with a rounded or truncate top, 2 $\frac{1}{2}$ –2 $\frac{3}{4}$  mm long. Seeds  $\pm$   $\frac{1}{2}$  mm. Cymes 1 $\frac{1}{2}$ –5 cm long, rarely longer (up to 10 cm), dense or rather loose. Stem in the living plant not or hardly ribbed, in dried specimens faintly and very closely ribbed; their basal sheaths dull or faintly shining . . . . . 1. *J. effusus*

(1) The author wishes to express his sincere thanks to Mr R. D. HOOGLAND for valuable help in identifying and discussing some aberrant Papuan and Philippine specimens of the very variable *J. prismatocarpus* R.Br.

2. Perianth  $3\frac{1}{2}$ –5 mm long, brown. Stamens 6. Capsule shortly mucronate on an obtuse apex,  $3$ – $3\frac{1}{4}$  mm long. Cymes 4–10 cm long, often rather lax. Stem in the living plant distinctly ribbed, ribs separated by interspaces which in dried specimens are as broad as the ribs themselves or broader. Basal sheaths of stems much shining. . . . . 2. *J. inflexus*
1. Inflorescence terminal, its bract not continuous with the stem.
3. Flowers solitary along the branches of the inflorescence, sometimes close or even very close together, but each subtended by a bract and 2 bracteoles. Bract and bracteoles thinly membranous. Leaves not septate. Annual. . . . . 3. *J. bufonius*
3. Flowers crowded into 3- or more-flowered heads; the single flowers ebracteolate or with only 1–2 bracteoles. Perennial . . . . . 4. *J. prismatocarpus*

1. *Juncus effusus* LINNÉ, Sp. Pl. (1753) 326; BAKER, Fl. Maur. (1877) 389; Hook. f. Fl. Br. Ind. 6 (1892) 392; CORDEMOY, Fl. Réunion. (1895) 146; BAKER, Fl. Cap. 7 (1897) 18; ASCH. & GR. Syn. 2, 2 (1904) 442; BUCH. Pfl. R. 25 (1906) 135; HEGI, Ill. Fl. Mitt. Eur. 2 (1909) 188; KOORD. Exk. Fl. 1 (1911) 285; RIDL. J.F.M.S. 84 (1917) 120; MERR. En. Philip. 1 (1922) 201; BACK. Handb. Fl. Jav. 3 (1924) 44; STEEN. Bull. J.B.B. III, 13 (1934) 220; DIELS, Bot. Jahrb. 62 (1929) 461; BURK. Ec. Prod. 2 (1935) 1271; RIDL. J. Bot. 73 (1935) 342.—*J. communis* E. MEYER, Junc. Gen. Mon. (1819) 20; MIQ. Fl. Ind. Bat. 3 (1855) 246; BTH. Fl. Austr. 7 (1878) 128; BAIL. Queensl. Fl. 5 (1902) 1668.—*J. sundaicus* RIDL. J. Bot. 73 (1935) 342.—Fig. 1, 2b.

Erect, quite glabrous perennial herb, 0.40–1.20 m high, with a horizontal, rather short, creeping, very short-jointed sympodial rhizome. Stems tufted, terete, in the living plant not or hardly ribbed, in dried specimens with very close-set faint longitudinal ribs; pith continuous. *Basal sheaths* closely embracing the stem, dull light- or darkbrown, obtuse, the inner often crowned by a deciduous awn. Not-flowering stems leafless (not computing the basal sheaths). Cymes pseudolateral, solitary, sessile, mostly  $1\frac{1}{2}$ –5 cm long, rarely longer (up to 10 cm), dense or lax, usually many-flowered; bract of the inflorescence continuous with the stem and resembling it, very acute, 5–20 cm long. *Flowers* partly sessile, partly stalked, stalks up to 8 mm long. Floral bracts 2, very close together, ovate, thin, nerveless,  $\pm \frac{3}{4}$  mm long. Tepals narrowly ovate-lanceolate, very acute, firm with transparent thin margins, subequal,  $2$ – $2\frac{3}{4}$  mm long, pale green or yellowish. Stamens 3, much shorter than the tepals, rarely 4–6; filaments thin, short; anthers comparatively large, linear. Style very short; stigmas long, erect, filiform. *Capsule* oblong, trigonous, with a round or truncate (in Malaysian specimens not impressed) apex, brown,  $2\frac{1}{2}$ – $2\frac{3}{4}$  mm long, 3-valved; placentas rather deeply intruded. Seeds numerous, oblong, not tailed,  $\pm \frac{1}{2}$  mm long, very faintly reticulate-ribbed.

Distr. World-wide in the temperate zones (specially in the N. hemisphere) and the mountainous districts of the tropics, not in Australia, in *Malaysia*: N. Sumatra (Atjeh), Java, Br. N. Borneo, Philippines (Luzon, Mindanao), New Guinea; undoubtedly native!

Ecol. Wet places, pools, morasses, lake-borders, river-banks, 1400 to 3000 m, locally numerous, but on the whole rare.

Uses. In the Malay Peninsula the pith is im-

ported from China and used as a drug (cf. BURKILL, Dict. 1935, 1272).

Vern. *Sumpu*, *J*, *udulan*, *J*, *pit-rus*, *D*, Philip-pines: *badili*, *sudsúd* (Ig.), *balli*, *piñgot* (Bon.).

2. *Juncus inflexus* LINNÉ, Sp. Pl. (1753) 326.—*J. glaucus* EHRH. Calam. no 55 et Beitr. Naturk. 6 (1791) 83; Hook. f. Fl. Br. Ind. 6 (1892) 393; ASCH. & GR. Syn. Mitt. Eur. Fl. 2, 2 (1904) 446; BUCH., Pfl. R. 25 (1906) 132; HEGI, Ill. Fl. Mitt.-Eur. 2 (1909) 185; BACK. Handb. Fl. Jav. 3 (1924) 44; STEEN. Bull. J.B.B. III, 13 (1934) 220.

Erect, quite glabrous, more or less glaucous perennial herb, 0.50–1.20 m high, with a horizontal, short, creeping, very short-jointed, sympodial rhizome. Stems tufted, terete or slightly compressed, in the living plant rather distinctly longitudinally ribbed, in dried specimens very distinctly so, with rather close-set ribs, separated by interspaces which, at least for the greater part, are as broad as the ribs themselves or broader; pith in the typical form divided by transverse interspaces, in some forms, possibly of hybrid origin (*J. effusus*  $\times$  *inflexus*?), otherwise quite like the typical form, continuous. *Basal sheaths* very closely embracing the stem, shining darkbrown, acute or obtuse, 5–20 cm long. Cymes pseudolateral, solitary, sessile, 4–10 cm long, rather lax, not very many-flowered. Bract of the inflorescence continuous with the stem and resembling it, very acute, 15–20 cm long. *Flowers* partly sessile, partly stalked; stalks up to 10 mm long. Floral bracts 2, very close together, unequal, thinly membranous,  $1\frac{1}{2}$ –2 mm long. Tepals narrowly ovate-lanceolate, very acute, brown, with a firm midrib and thinly membranous margins,  $3\frac{1}{2}$ –5 mm long, slightly unequal. Stamens 6, often partly abortive, shorter than the tepals; filaments thin, moderately long; anthers linear. Style short, its arms rather long, erect or ascending. *Capsule* oblong obtuse, with a distinct,  $\frac{1}{4}$ – $\frac{1}{3}$  mm long mucro (persistent style-base),  $3$ – $3\frac{1}{4}$  mm long, 3-celled, with very thin septa. Seeds numerous, oblong, very faintly longitudinally ribbed, very faintly transversally striate between the ribs, brown,  $\frac{3}{4}$ – $\frac{5}{6}$  mm long.

Distr. Europe, N. and S. Africa, W. and SE. Asia, Ceylon, and introduced in New Zealand, in *Malaysia*: Java, thus far only collected in the easternmost part.

Ecol. Wet places, river-banks, 2100–2700 m, locally numerous but on the whole rare.

Vern. *Mendon banyu*, *J*, *zeegroene rus*, *D*, *hard rush*, *E*.



Fig. 1. *Juncus effusus* L. Tufts in a shallow pool; water covered by *Lemna* & *Azolla*.  
E. Java, ca 1950 m alt.

Note. I am not at all convinced that the specimens with a continuous pith but otherwise quite like the typical form are of hybrid origin. See also HEGI, *l.c.*

**3. *Juncus bufonius* LINNÉ, Sp. Pl. (1753) 328; BTH. Fl. Austr. 7 (1878) 127; HOOK. f. Fl. Br. Ind. 6 (1892) 392; BAILEY, Queensl. Fl. 5 (1902) 1667; ASCH. & GR. Syn. Mitt.-Eur. Fl. 2, 2 (1904) 420; BUCH., Pfl. R. 25 (1906) 105; HEGI, Ill. Fl. Mitt.-Eur. 2 (1909) 192; MERR. En. Philip. 1 (1922) 201; STEEN. Bull. J.B.B. III, 13 (1934) 220.**

Very variable, pale-coloured annual, usually 10–30 cm long, rarely longer. Stems tufted, all fertile, erect, erecto-patent or decumbent, slender, terete, soft, often branched, leafy. *Leaf-sheaths* rather

long, not auricled. Leaves linear, very narrow, channelled down the face, the lowmost up to 16 cm long, the higher shorter. Inflorescence terminal, branched; branches erect or obliquely erect, rather straight. *Flowers* either solitary and remote or in more or less remote (sometimes almost crowded) clusters of 2–6; each flower at the base with a bract and 2 bracteoles; flowers nearly sessile, pale-coloured, very variable as to size, 3–7 mm long. Bracts and bracteoles thinly membranous, ovate, acute. Tepals narrowly ovate-lanceolate, very acute, the 3 inner often much smaller than the outer. Stamens 6, in the topmost flowers often 3. Style distinct; stigmas straight. *Capsule* oblong, trigonous, usually shorter than the perianth, 3–5 mm long; placentas at length often detached from



Fig. 2. *a.* *Juncus prismatocarpus* R.BR., *b.* *Juncus effusus* L., rootstock and inflorescence,  $\times 2/3$ .

the valves, either free or cohering into a central column. Seeds numerous, ellipsoid, tailless, brown, extremely faintly ribbed,  $1/3-1/2$  mm long.

**Distr.** Almost cosmopolitan in the northern temperate zone, in the tropics restricted to the mountainous regions, in *Malaysia*: Philippines (Luzon), according to MERRILL *l.c.*, probably introduced.

**Ecol.** Permanently or temporarily humid localities, often gregarious. In Luzon along bridle-trails in mossy forests at 1900 m.

**Vern.** *Paddengras*, D, *toad rush*, E.

**4. *Juncus prismatocarpus*** R.BR. *Prod.* (1810) 259; E. MEY. *Syn. Junc.* (1822) 38; MIQ. *Fl. Ind. Bat.* 3 (1855) 246; BTH. *Fl. Austr.* 7 (1878) 131; BAIL. *Queensl. Fl.* 5 (1902) 1669; BUCHENAU, *Pfl. R.* 25 (1906) 180, f. 89; KOORD. *Exk. Fl.* 1 (1912) 285; RIDL. *J. Mal. Br. R. As. Soc.* 87 (1923) 103; BACK. *Handb. Fl. Jav.* 3 (1924) 44; STEEN. *Arch. Hydrob. Suppl. Bd* 10 (1932) 295; Bull. J.B.B. III, 13 (1934) 221; RIDL. *J. Bot.* 73 (1935) 343 *incl. var. leschenaultii* (GAY) BUCH.—*J. leschenaultii* J. GAY *ex* LAH. *Mém. Soc. Linn. Paris* 3 (1827) 205; C. B. ROBINSON, *Philip. J.Sc.* 3 (1908) Bot. 176; MERR. *En. Philip.* 1 (1922) 201.—*J. lamp(ri)ocarpus* (non EHRH.) RIDL. *Trans. Linn. Soc. Lond. Bot.* II, 9 (1916) 231; GIBBS, *Arfak* (1917) 100.—**Fig. 2a.**

Perennial quite glabrous herb, (15-)30-70(-100) cm high. Stems tufted, erect, erecto-patent, ascending or floating, or some of them prostrate and then often rooting and emitting erect flowering branches, terete or compressed, with continuous pith. *Leaves* few, partly basal, partly cauline, on often long sheaths with 2 short, obtuse auricles at the top, linear, acute, rather thick, compressed, hollow but divided by rather remote cross-partitions into compartments which, in dried specimens, give them a jointed appearance, 5-20 cm long. *Inflorescence* a terminal very lax corymb made up of few to many usually 5-10-, but sometimes fewer- or more-flowered heads which sometimes bear in their centre a small tuft of short, very narrow leaves; the heads partly sessile at the ramifications of the inflorescence, partly on stalks of  $3/4-5$  cm length. Bracts in the heads ovate-lanceolate, acute, much shorter than the perianth, thinly membranous. Perianth  $3 1/2-4 1/2$  mm long. Tepals of about equal length, ovate-lanceolate, very acute, longitudinally nerved. Stamens 3, before the outer tepals, shorter than these, sometimes 1-3 before the inner tepals; filaments rather long; anthers linear, sometimes very short. Style very short; stigmas much longer, often recurved or sinuous. *Capsule* pale brown, rarely castaneous, narrowly prismatic, with prominent acute angles, rarely ovate with rounded angles, acute, varying from slightly shorter to considerably longer than the perianth; placentas not or hardly intruded, hence the fruit 1-celled. Seeds numerous, oblong, rather regularly longitudinally ribbed with faint, rather remote transverse nerves between the longitudinal ones, yellow, *ca* 0.5-0.8 mm long.

**Distr.** Ceylon, SE. to E. Asia, Australia, Tasmania and New Zealand, in *Malaysia*: N. Sumatra,

W.-Central Java, Philippines (Luzon, Mindanao), New Guinea.

Ecol. Between 1000 and 3225 m altitude in pools, marshy plains, on swampy river-banks, locally numerous.

Vern. *Mëndongan, merakan, J.*

Notes. By BUCHENAU, *l.c.*, 2 varieties are distinguished, differing mainly in habit. *Var. genuinus* BUCHENAU (Bot. Jahrb. 6, 1885, 204) includes the more robust specimens with many-flowered inflorescences, *var. leschenaultii* (GAY) BUCHENAU (Bot. Jahrb. 6, 1885, 205; *Juncus leschenaultii* GAY in LAHARPE, Monogr. Jonc. 1827, 137) the smaller specimens with poorly developed inflorescences. These varieties are not sharply separated, *var.*

*genuinus* is found throughout Malaysia, most extreme *var. leschenaultii* only in the Philippines and New Guinea, though intermediates occur throughout Malaysia.

The leaves in most Malaysian specimens of *var. leschenaultii* are pluritubular: *subvar. pluritubulosus* BUCHENAU (Monogr. Juncac., 1890, 311; Pfl. R. 25, 1906, 181), in part of the New Guinea specimens they are unitubular: *subvar. unitubulosus* BUCHENAU (*l.c.*, 1890, 312; *l.c.*, 1906, 181). Part of the latter specimens have the fruit castaneous, ovate with transitions to typical *prismatocarpus*-fruit (collections from the Wissel Lakes and Lake Habbema). This type of fruit does not seem to occur outside this limited area.

## 2. LUZULA

DC. Fl. Franç. ed. 3, 3 (1805) 158.

Perennial herbs, usually tufted and stoloniferous. *Leaves* for the greater part crowded at the base of an erect or ascending stem, grass-like, linear from a sheathing base, tapering towards the often thickened or shortly acute apex, frequently fringed with long, very fine white hairs. *Flowers* either solitary or subsolitary and loosely paniculate or crowded into dense clusters; the latter often forming a raceme or panicle which may be contracted into a dense spikelike inflorescence; each flower subtended by a scarious bract and enclosed at the base by 1–2 scarious short bracteoles. Tepals 6, free, glumaceous, equal or slightly unequal, ovate-lanceolate, acute or partly obtuse. Stamens 6, singly before the tepals; filaments thin; anthers erect, oblong or linear. Ovary sessile, 1-celled; ovules 3, erect from a very short basal placenta; style 1, deciduous; arms 3, usually slender. *Fruit* ellipsoid or obovoid, often crowned by the style-base, 3-valved. Seeds 3 or fewer, oblong, faintly reticulate-ribbed, often with a basal or apical elaiosome; embryo small, near the hilum; albumen subfarinaceous.

Distr. Species  $\pm 60$ , in both hemispheres in the frigid, temperate and torrid zones, in the latter restricted to the mountainous districts. In *Malaysia* 2 species, only high up in the mountains.

### KEY TO THE SPECIES

1. Flowers solitary or subsolitary, united into a very loose, rather large panicle. Elaiosome minute, at the top of seed. Tips of leaves terminated by a very short, triangular, acute point, not thickened. **1. *L. effusa***
1. Flowers in dense clusters; these sometimes solitary but usually united in small numbers into short racemes or panicles, which may be contracted into a spike-like inflorescence. Elaiosome distinct, at the base of the seed. Tips of leaves rounded or very obtuse, distinctly thickened. **2. *L. campestris***

**1. *Luzula effusa*** BUCHENAU, Krit. Verz. Junc. (1880) 53, 88; Bot. Jahrb. 6 (1885) 196; *ibid.* 12 (1890) 106; Hook. f. Fl. Br. Ind. 6 (1892) 401; BUCH., Pfl. R. 25 (1906) 61; MERR. En. Philip. 1 (1922) 202; STEEN. Bull. J.B.B. III, 13 (1934) 221.

Stoloniferous erect or ascending perennial, 25–70 cm high. Lower leaves crowded at the base of the stem; the higher ones more remote and gradually diminishing in size; all leaves linear from a sheathing base, flat, with a much tapering apex, terminated by a very short, shortly triangular not thickened point, along the smooth margins and often also on the surfaces with a few scattered long very fine white hairs, the larger leaves 6–12 cm by 6–12 mm. *Flowers* in an elongate very lax panicle, the lower branches of which arise from the higher

leaf-axils; branches often nodding or drooping; flowers for the greater part solitary on pedicels 4–12 mm long, for the rest shortly pedicelled or subsessile. Perianth 2–2½ mm long. Tepals narrowly ovate-lanceolate, very acute. Stamens 6, slightly shorter than the perianth; filaments very thin,  $\pm 1\frac{1}{4}$  mm long; anthers oblong,  $\frac{1}{2}$ – $\frac{3}{4}$  mm. *Capsule* about as long as the perianth, broadly ellipsoid-obovoid, trigonous, crowned by the style-base. Seeds usually 3, erect, oblong or oblong-obovoid, brown, faintly reticulate-ribbed, on the rounded top with a minute pale elaiosome,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long.

Distr. E. Himalaya to China, in *Malaysia*: Philippines, Br. N. Borneo (Kinabalu), S. Celebes (Bonthain, Latimodjong), New Guinea.

Ecol. In burnt forest-fringes, scattered through forests, on steep rock walls, in upper border of mossy forests, 2100–3300 m.

2. *Luzula campestris* (LINNÉ) DC. Fl. franç. 3 (1805) 161; R. Br. Prod. (1810) 591; Miq. Fl. Ind. Bat. 3 (1855) 245; Bth. Fl. Austr. 7 (1878) 123; BUCH. Bot. Jahrb. 12 (1890) 155; Hook. f. Fl. Br. Ind. 6 (1892) 401; ASCH. & Gr. Syn. Mitt.-Eur. Fl. 2, 2 (1894) 521; BAIL. Queensl. Fl. 5 (1902) 1607; BUCH. Pfl. R. 25 (1906) 83; HEGI, Ill. Fl. Mitt.-Eur. 2 (1909) 230; MERR. En. Philip. 1 (1922) 201; STEEN. Bull. J.B.B. III, 13 (1934) 221.—*Juncus campestris* LINNÉ, Sp. Pl. (1753) 329.

var. *australasica* (STEUD.) BUCHENAU, Oesterr. Bot. Z. (1898) 216; DIELS, Bot. Jahrb. 62 (1929) 461.—*Luzula australasica* STEUD. Syn. Pl. Glum. 2 (1855) 294.

Erect, often tufted perennial herb, 10–36 cm high. Stem glabrous, hollow. Leaves for the greater part crowded at the base of the stem, linear from a sheathing base, with a narrowed, rounded or very obtuse distinctly thickened apex, along the smooth margins fringed with rather remote long very fine white hairs, flat, firmly herbaceous, 5–10 by 3–5 mm; higher stem-leaves few, remote, gradually diminishing in size, the topmost acting as bract to the inflorescence. Spikelets in dense head-like clusters, all or for the greater part collected at the apex of the stem into a short, dense, often spiciform  $1\frac{1}{2}$ –3 cm long inflorescence. Floral bracts elongate-

ovate, very acute, distinctly paler than the spikelets. Tepals oblong-ovate, very acute,  $\pm 2\frac{1}{2}$  mm long, in their upper halves dark-brown, often pale-margined, subequal or slightly unequal. Stamens 6, slightly shorter than the perianth; filaments rather long; anthers shortly linear-oblong; style  $1\frac{1}{2}$  mm. Stigmas longish. Capsule broadly obovoid, rounded at the top, distinctly shorter than the perianth,  $\pm 2$  mm long. Seeds 3 or fewer, oblong, brown, with a rather large, basal, white elaiosome, faintly reticulate-ribbed,  $\pm 1\frac{1}{4}$  mm long.

Distr. Extremely polymorphous, distributed throughout the globe, in *Malaysia*: Philippines (Luzon) and New Guinea.

Ecol. Alpine grasslands on sandy banks of streams, in recently burnt forest-areas, on slopes in pine-forests, extending into the mossy forest along trails, locally common, 2000–3700 m.

Vern. *Veldbies*, D, *wood rush*, E.

Note. In *Malaysia* hitherto only the above described form has been collected.

#### Excluded

'*Juncus communis* MEY.' sec. KURZ, Natuurk. Tijd. N.I. 27 (1864) 221, 'in swampy places round the lime-kiln at Muntok', Banka Island.

I have not traced the specimen on which this record is based, but the fact that *J. communis* = *J. effusus* L. has never been found below 1400 m alt. leads to the conclusion that KURZ's identification is wrong, and that he had before him some Cyperacea.



## PEDALIACEAE (C. A. Backer, Heemstede)

Annual or perennial *herbs*, often strongly smelling, frequently clothed with glandular or mucigenous hairs (the latter consisting of a very shortly stalked 4-lobed knob becoming slimy when wetted). *Leaves* opposite or the upper spirally arranged, exstipulate, petioled, simple or the lower 3-partite or palmately 3-foliolate. *Flowers* ♂, either solitary in leaf-axils (often between 2 glands), or in terminal racemes, nodding, zygomorphic. Calyx deeply 5-partite. Corolla much exceeding the calyx, gamopetalous, mostly very oblique; tube widened upwards; lobes 5, in bud imbricate, the anterior one much the largest. *Stamens* inserted near base of corolla, included, either 2 (anterior ones) perfect with 3 staminodes or 4 perfect, didynamous, with or without 1 posticous staminode; anthers free or cohering in pairs, 2-celled; connective often gland-tipped; cells parallel or widely diverging, opening lengthwise. Disk hypogynous, fleshy. Ovary superior, either 1-celled with 2 opposite parietal deeply intruded, T-shaped placentas touching in the middle and consequently spuriously 4-celled, or 2–4-celled and then the cells often halved by a parietal radial spurious dissepiment. Ovule either 1 in each compartment, or numerous and superposed. Style long; stigma 2–4-lamellate. *Drupe* or capsule; cells 1- of more-seeded. No endosperm; cotyledons flat.

Distr. About 60 *spp.* belonging to 3 genera (*Martyniaceae* proper) in the tropics and subtropics of America and to  $\pm 15$  in the Old World which, the Australian *Josephinia* excepted, are confined to or centering in Africa; many genera are monotypic. Some *spp.* are now ubiquitous weeds having escaped from cultivation. Of the genera treated here only *Josephinia* is native to Malaysia.

Ecol. The bulk of the *spp.* is found in dry regions or on the beach. They often show structures adapted to a xerophytic habitat. The fruits of the *Pedaliaceae* are often provided with hooks, sometimes bizarre in shape, or wings.

Notes. *Martyniaceae* are included here in *Pedaliaceae*.

### KEY TO THE GENERA

1. Flowers solitary, axillary. Pedicels inserted between 2 small sessile glands, short. Ovary densely hairy.
2. Ovules and seeds  $\infty$ , superposed in each cell. Capsule oblong, unarmed, dehiscent. Higher leaves often spirally arranged. . . . . 1. *Sesamum*
2. Ovules and seeds 1 in each cell. Fruit ellipsoid to subglobose, spiny, indehiscent. Leaves opposite. . . . . 2. *Josephinia*
1. Flowers in erect terminal racemes. Pedicels not inserted between 2 glands, elongate. Ovary glabrous. . . . . 3. *Martynia*

### 1. SESAMUM

LINNÉ, Sp.Pl. (1753) 634; Gen. Pl. (1754) no 782.

Erect or decumbent *herbs*, beset with very short, white, mucigenous hairs, moreover often with much longer articulate hairs. *Leaves* opposite or the upper spirally arranged; the larger ones sometimes compound or deeply divided, the smaller simple, entire or shallowly serrate-dentate. *Flowers* solitary in the axils of the higher leaves. Calyx persistent, small. Corolla-tube decurved, gradually widened upwards, at the back of the base subgibbous, inside beneath the insertion-point of the filaments with a ring of hairs; lobes of limb patent, rounded. Stamens 4, didynamous; anthers free, with a bifid base; cells  $\pm$  parallel; connective gland-tipped; staminode minute or absent. Disk equal. Ovary (in normal flowers) 2-celled; cells halved by a parietal radial false dissepiment; each compartment containing many 1-seriate superposed ovules; stigma (in normal flowers) 2-lamellate. *Capsule* oblong or slightly broadened upwards, acuminate or obtuse-rounded, obtusely quadrangular with 4 longitudinal grooves, unarmed, dehiscing longitudinally from

the top more or less deeply down; the false dissepiments splitting longitudinally. Seeds in each compartment numerous, horizontal or suboblique, much compressed, obovate with a rounded apex, in their basal part or throughout their length margined or very narrowly winged; testa on the broad surfaces either smooth, finely scrobiculate or transversely ribbed. Seeds often rich in oil.

Distr. Species  $\pm 18$  centering in the warmer regions of Africa, few in Asia; 2 of them frequently cultivated as an oil-seed, viz *S. indicum* and *S. radiatum*. Both of these occur in *Malaysia*, where *S. indicum* is very common, *S. radiatum*, on the whole, very rare.

Note. For abnormal flowers see the note under *S. indicum*.

## KEY TO THE SPECIES

1. Quite ripe seeds on their broad surfaces with finely reticulate ribs or almost smooth. Fruit crowned by a very conspicuous subulate beak. Lowest leaves often deeply divided or palmately compound.

1. *S. indicum*

1. Quite ripe seeds on their broad surfaces, especially on the flatter one, with many transverse ribs emanating from a central longitudinal field. Fruit with a rounded or very obtuse apex, not or hardly beaked. Lowest leaves simple, not deeply divided . . . . . 2. *S. radiatum*

1. *Sesamum indicum* LINNÉ, Sp. Pl. (1753) 634; BURM. f. Fl. Ind. (1768) 133; BLUME, Bijdr. (1826) 778; BLANCO, Fl. Fil. (1837) 507; ed. 2 (1845) 353; ed. 3, 2 (1878) 290, t. 273; CURTIS, Bot. Mag. 41 (1815) t. 1688; SPAN. Linnaea 15 (1841) 327; DC. Prod. 9 (1845) 250; MIQ. Fl. Ind. Bat. 2 (1858) 760; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1884) 387; GRESH. Schets. Nutt. Ind. Pl. (1894) 21–24, f.; KOORD. Versl. Minah. (1898) 553; BAILEY, Queensl. Fl. 4 (1901) 250; TROMP DE HAAS, Teysm. 14 (1903) 389; BOORSMA, *ibid.* 15 (1904) 39; STAPP in Fl. Trop. Afr. 4, 2 (1906) 558; KOORD. Exk. Fl. 3 (1912) 186; RIDLEY, Fl. Mal. Pen. 2 (1912) 553; OCHSE & BAKH. v. D. Br. Veg. (1931) 583, f. 354; NOHARA, J. Coll. Agr. Tokyo 12 (1933) 228; GAGNEP. in Fl. Gén. I.C. 4 (1935) 609; LANGHAM, J. Hered. 38 (1947) 347; STEEN. Fl. Schol. Ind. (1949) 357; BACKER, Bekn. Fl. Java em. ed. 9 (1949) fam. 197, p. 3.—*Sesamum orientale* LINNÉ, Sp. Pl. (1753) 634; BURM. f. Fl. Ind. (1768) 133; GAERTN. Fruct. 2 (1791) 132, t. 110; MOR. Syst. Verz. (1846) 46; MERR. Fl. Man. (1912) 431; Interpr. Herb. Amb. (1917) 469; Sp. Blanc. (1918) 351; Bibl. En. Born. Pl. (1921) 526; W. H. BROWN, Minor Prod. Philip. For. 2 (1921) 168–172, f. 58; MERR. En. Philip. 3 (1923) 448; HEYNE, Nutt. Pl. (1927) 1372; BACK. Onkr. Suiker (1931) 630; HILDEBRAND, Bull. Appl. Bot. Leningr. I, No 2 (1932) 3; BURK. Dict. Ec. Prod. 2 (1935) 1994; HENDERSON, Mal. Wild Fl. 2 (1950) 363, f. 339.—*Volkameria orientalis* O.K. Rev. Gen. 2 (1891) 481.—*Sesamum indicum nigrum* and *album* RUMPH., Herb. Amb. 5, 204, t. 76, f. 1.

Strongly smelling annual, 0.15–1.50, rarely up to 2 m high, often branched. Stems and branches in their upper part obtusely quadrangular, with furrowed sides. Lower leaves opposite, rather long petioled, ovate from a rounded or obtuse base, acute or rather obtuse, in robust specimens often 3-lobed, 3-partite or palmately 3-foliolate, in feebler ones undivided; higher leaves gradually shorter petioled, more ovate-oblong-lanceolate or even linear from an acute base; petioles of lower leaves 2–15 cm, of highest leaves frequently only a few mm; limb 4–20 cm by 1/2–15 cm, in large leaves

coarsely or superficially serrate-dentate. Pedicels erecto-patent, 2–5 mm. Calyx 4 1/2–7 mm long, in fruit thickened and obconical; segments oblong or ovate-oblong, rather obtuse. Corolla totalling 2 1/4–3 1/2 cm, in pale-seeded forms white, in brown- and black-seeded forms violet, often spotted with yellow. Filaments glabrous; anthers 2 1/2–4 mm, glabrous or along the margins thinly hairy; staminode minute, reflexed, or wanting. Ovary densely pilose; style glabrous, white, 1–1 1/4 cm; stigmatic lamellae lanceolate, rather acute. Capsule erect, prismatic from a rounded base or slightly broadened upwards, at the rounded apex abruptly contracted into a conspicuous shortly subulate, rather obtuse beak, 1 3/4–3 cm (beak included) by 6–12 mm, finally splitting down to the very base; endocarp of the valves with an acuminate apex. Seeds 2 1/2–3 mm long, yellowish white, brown or black, finely reticulate or almost smooth; one of the broad surfaces of the seed very narrowly margined all round, often with a longitudinal midrib; the opposite surface slightly more convex and margined only at the base, without a midrib.

Distr. Herb of ancient cultivation, native country not known with certainty: Africa or possibly Asia. At the present time grown for its oleiferous seeds throughout the warm regions of the world; rather commonly cultivated throughout Malaysia; not yet reported from New Guinea.

Ecol. In Malaysia cultivated from the plains up to  $\pm 1000$  m, especially in the drier regions. Frequently met with on fields as a relic of cultivation, also on road-sides and in open grassy localities, but there, as a rule, not firmly established. In 1919 I saw in several islands of the Kangean Archipelago apparently wild specimens in places where, according to the natives, the plant had never been cultivated and where it bore no vernacular name.

Uses. The seeds are pressed to obtain oil; also used as an ornament for the top of cakes.

Vern. Many names of which *widjèn* and *lenga* with some variants are the commonest.

Notes. A monstrous white-flowered cultivated form of this species is characterized by a 4-celled ovary and 4 stigmatic lamellae; in this form also

each ovary-cell is halved by a longitudinal parietal false dissepiment, which may be only partially developed. The capsule is proportionally much broader than that of normal forms.

**2. *Sesamum radiatum*** SCHUM. in SCHUM. & THONN. Beskr. Guin. Pl. (1827) 282; BOORSMA, Teysm. 15 (1904) 39; STAFF, Fl. Trop. Afr. 4, 2 (1906) 557; ALSTON, Handb. Fl. Ceyl. 6 (1931) 221; BACKER, Bekn. Fl. Java, em. ed. 9 (1949) fam. 197, p. 3.—*Sesamum occidentale* REGEL & HEER, Ind. Sem. Hort. Turic. (1842) ex DC. Prod. 9 (1845) 250.—*Sesamopteris radiata* DC. Prod. 9 (1845) 251.

Disagreeably smelling annual, 0.40–1.20 m high or sometimes higher, usually branched; stems and branches in their upper parts obtusely quadrangular, with furrowed sides. *Leaves* varying from ovate-elliptic (the lower) to narrowly oblong (the upper), at the base and apex acute or rather obtuse,  $3\frac{1}{2}$ –11 cm by  $1\frac{1}{4}$ –4 cm; lower more or less coarsely dentate-serrate, but never deeply divided or compound; higher entire or nearly so; petioles  $1\frac{1}{4}$ – $2\frac{1}{2}$  cm, from the base of the stem upwards gradually diminishing in length. Pedicels erect, 4–8 mm, in fruit thickened and obconical. Calyx 5–7 mm,

segments oblong or ovate-oblong, rather obtuse. *Corolla* totalling 3–4 cm, violet or violet with white. Filaments glabrous; anthers 4–5 mm, hairy on the back; staminode absent. Ovary densely pilose; style glabrous, white; stigmatic lamellae oblong or lanceolate. *Capsule* erect, prismatical from a rounded base, with a rounded or very obtuse apex, rather densely pilose,  $2\frac{1}{2}$ –3 cm by 8–10 mm, finally splitting down to the very base; endocarp of valves slightly retuse at the apex, crowned by a short central point. *Seeds*  $\pm$  3 mm long, brown or black, dull or feebly shining; on both surfaces, especially on the flatter one, with several subhorizontal ribs emanating from a central longitudinal field; the flatter surface all around with a sharp margin; the opposite surface distinctly more convex, on the one side delimited by the same margin, on the other in the lower part delimited by a second sharp margin uniting with the other one beneath the apex of the seed; margins much more pronounced than in the preceding species.

Distr. Native of tropical W. Africa, where, according to BURKILL, it is cultivated for its oil-containing seeds. In other warm countries run wild. In *Malaysia*: Malay Peninsula, Sumatra, N. Borneo.

## 2. JOSEPHINIA

VENT. Jard. Malm. 2 (1804) 67, t. 67.

Erect or decumbent *herbs*, beset with very short, mucigenous hairs, moreover often with shorter or longer ordinary hairs. *Leaves* dentate or divided into 3 distinct segments. *Flowers* in the higher leaf-axils. Calyx persistent, small, segments subequal or posterior one smaller. Corolla-tube decurved, much widened upwards, at the back of the base subgibbous, inside beneath the insertion-point of the filaments with a dense ring of short hairs; lobes of limb patent. Stamens 4, didynamous; anthers free; cells  $\pm$  parallel, with a deeply bifid base; connective gland-tipped. Disk on the posterior side slightly thickened. Ovary 2–4-celled, cells halved by a parietal radial false dissepiment; each compartment containing a single basal erect ovule; stigmatic lamellae equal in number to ovary-cells. *Fruit* ovoid-oblong-globular, beaked or not, aculeate, 4-, 6- or 8-celled; cells 1-seeded. Seeds erect, oblong, not winged.

Distr. Species 4 in Australia: one of them extending to *Malaysia* as far West as Java.

**1. *Josephinia imperatricis*** VENT. Jard. Malm. 2 (1804) 67, t. 67; R.Br. Prod. (1810) 520; DECNE, Nouv. Ann. Mus. 3 (1834) 404; SPAN, Linnaea 15 (1841) 327; DC. Prod. 9 (1845) 255; MIQ. Fl. Ind. Bat. 2 (1858) 761; BTH. Fl. Austr. 4 (1869) 557; TEYSM. Nat. Tijds. N.I. 34 (1874) 462; FORBES, Nat. Wand. (1885) 513; KOORD. Versl. Minah. (1898) 554; Exk. Fl. 3 (1912) 186; BACKER, Bull. J.B.B. II, 12 (1913) 20; Trop. Natuur 12 (1923) 19–21, f. 2; DE VOOGE, Trop. Natuur 26 (1937) 163; BACKER, Bekn. Fl. Java em. ed. 9 (1949) fam. 197, p. 4.—*Josephinia celebica* Bl. Bijdr. (1826) 779.—*J. grandiflora* R.Br. Prod. (1810) 520; BTH. Fl. Austr. 4 (1869) 556; F.v.M. Descr. Not. Pap. Pl. 1 (1875) 11; HEMSL. Bot. Chall. 3 (1885) 172; BAILEY, Queensl. Fl. (1901) 1140; WHITE, J. Arn. Arb. 10 (1929) 273.

Rather long-lived *herb*, strongly smelling (like *Sesamum indicum*), frequently woody at the base, with a robust, often very long (penetrating into the soil to a depth of many dm), reddish brown taproot. Stem frequently divided at or near the base in widely divaricating, ascending, long, often sinuous, terete branches,  $\frac{1}{2}$ – $1\frac{3}{4}$  m long, at the top densely and finely hoary-pubescent. *Leaves* ovate, ovate-oblong or oblong, from a rounded, obtuse or acute base, gradually tapering upwards or shortly acuminate, acute, entire or the larger ones coarsely dentate-serrate, upper side less densely hairy than below; lower 3–12 cm by  $\frac{3}{4}$ –6 cm; topmost often small; petiole densely hoary-pubescent, that of lower leaves 2–7 cm, of higher gradually shorter. Pedicels erecto-patent, 3–5 mm, rather densely hoary-pubescent, after anthesis somewhat thick-



Fig. 1. *Josephinia imperatricis* VENT. Stem with flowers and fruits,  $\times 2/3$ .

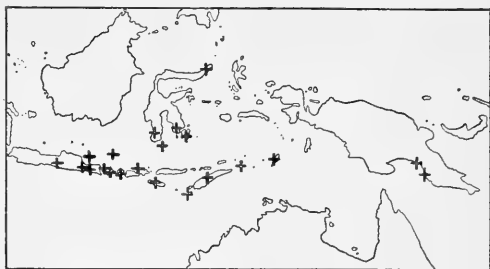


Fig. 2. Localities of *Josephinia imperatricis* VENT. in Malaysia.

ened, not or hardly lengthened. *Calyx* externally densely hoary-pubescent, 4–5 mm long; segments oblong, rather acute or rather obtuse; posterior segment shorter, 2 anterior ones longer than the others. *Corolla* pale pink or pale violet, in the throat and on the anterior segment dotted with red or violet, externally densely shortly pubescent, totalling  $2\frac{3}{4}$ – $3\frac{1}{4}$  cm; narrow basal part of tube  $2\frac{1}{2}$ –4 mm; posterior and lateral lobes of corolla very short; anterior lobe much larger, broadly ovate, rounded,  $1\frac{1}{4}$  cm long. Disk thick. Ovary densely appressed hairy, usually 3-, sometimes 4-celled (consequently with 6 or 8 compartments); stigma 3- or sometimes 4-lamellate. *Fruit* globose or broadly ellipsoid, crowned by a narrowly pyramidal, short, obtuse beak, 11–15 mm diam. (spines included), densely patently hoary; spines rather strong, conical,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long, obtuse as long as the fruit remains attached to the plant, afterwards drying up and becoming much sharper; endocarp woody. Testa thick.

*Distr.* N-NE. Australia and *East Malaysia*: South- and eastcoast of the eastern half of Java, Madura, Kangean Arch., Lesser Sunda Islands (Bali, Lombok, Sumba, Timor, Leti, Moa), Saleyer, Buton, S. & NE. Celebes, Tanimber Islands, and SE. New Guinea (incl. adjacent isl.).

*Ecol.* Beach-wall and sandy fields behind it, usually 1–5 m above sealevel, but sometimes much higher (up to 300 m), on the whole rather rare but locally often gregarious. The fruits are transported by the sea and by tillage of the soil. They are produced in great numbers.

*Vern.* Several but very local and of little value.

*Note.* TEYSMANN recorded from Timor a second species of *Josephinia* (Nat. Tijds. N.I. 34, 1874, 462) but his material belongs to *J. imperatricis*. I can find no argument for separating *J. grandiflora* from the latter, the difference in the fruit-structure as described by R. BROWN being due to the appearance of false dissepiments during ripening.

### 3. MARTYNIA

LINNÉ, Sp.Pl. (1753) 618; Gen. Pl. (1754) no 671.

Annual erect herb, clothed with patent, long, glandular-viscid hairs. *Leaves* opposite, long-petioled, broad, palmatinerved. *Flower* in the axil of a deciduous bract,

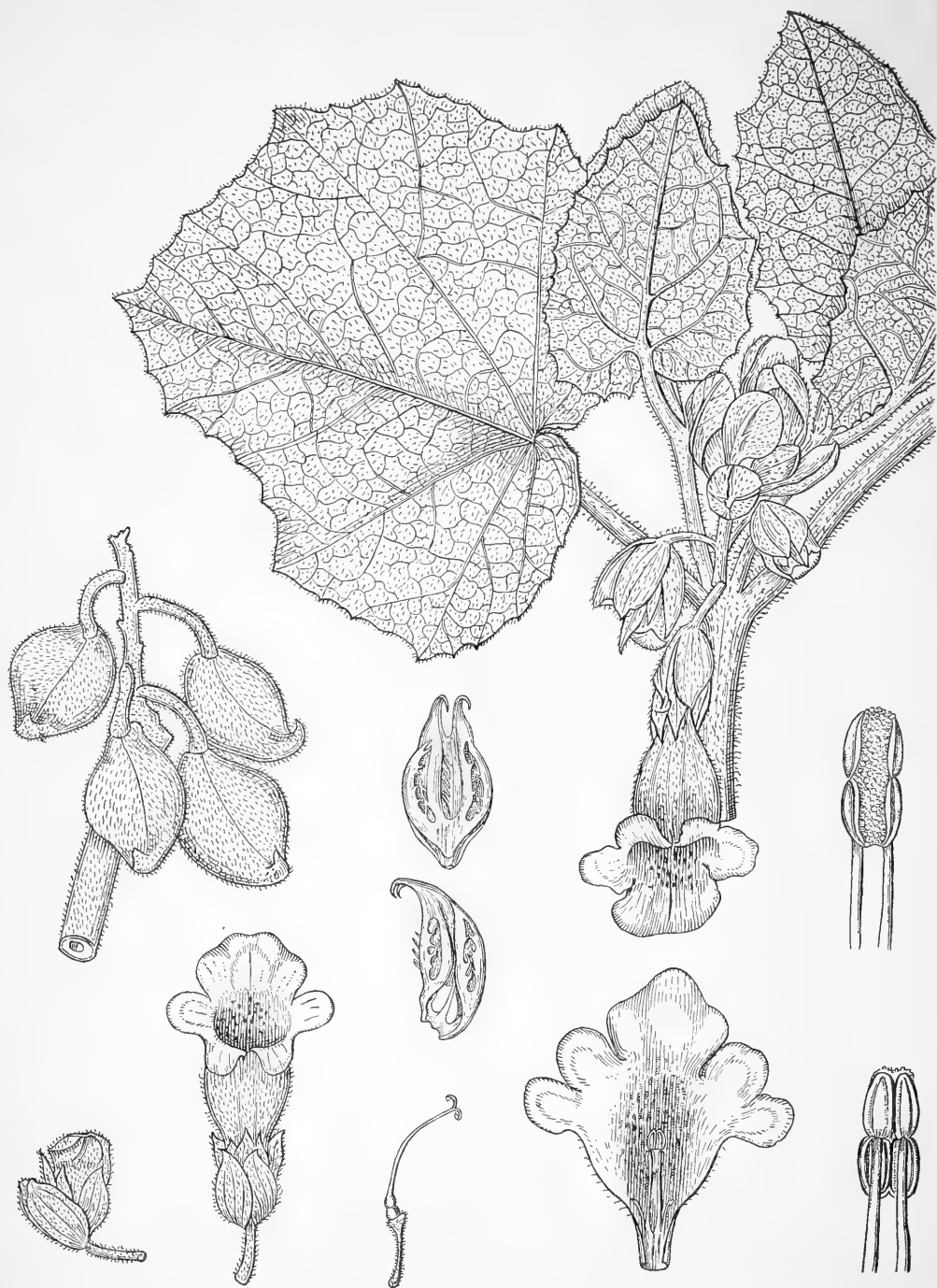


Fig. 3. *Martynia annua* L. Flowering stem-top, a branch with fruits, two pyrenes, and details of flowers, all  $\times \frac{2}{3}$ , anthers  $\times 3$ .

at the base with 2 membranous bracteoles. Calyx 5-partite to the base; segments unequal, 2 anterior ones broader than the others, posterior segment longest. *Corolla* obliquely campanulate-thimbleshaped, on the anterior side much dilated above the short basal part; lobes broad, very unequal, anterior one much the largest. Perfect stamens 2 (anterior ones); anthers cohering; cells widely divergent; connective glandless; staminodes 3. Disk unequalsided. Ovary 1-celled, divided into 4 compartments by 2 deeply intruding, parietal, opposite, T-shaped placentas touching in the middle rendering the ovary spuriously 4-celled; each compartment with 1 ovule pendent from its apex; stigma unequally 2-lamellate. *Fruit* a beaked drupe; pericarp rather thin, 2-valvate, deciduous; endocarp remaining attached during a long time to the pedicel, crowned by 2 strong, clawlike very sharp hooks, woody, with 8 strong, rounded longitudinal ribs and a central empty cavity; compartments 1-seeded. Seed oblong.

Distr. Monotypic genus, native of Mexico, naturalized in several tropical and subtropical regions.

**1. *Martynia annua* LINNÉ, Sp. Pl. (1753) 618; KOORD. Exk. Fl. 3 (1912) 187; DAMMERMAN, Nat. Tijds. N.I. 86 (1926) 44; Trop. Natuur 15 (1926) 74; BACKER, Bekn. Fl. Java em. ed. 9 (1949) fam. 197, p. 2.—*Martynia diandra* GLOXIN, Obs. (1785) 14, t. 1; JACQ. Hort. Schoenbr. 3 (1798) 21, t. 289; LINDL. Bot. Reg. n.s. 9 (1836) t. 2001; DC. Prod. 9 (1845) 253; CLARKE, Fl. Br. Ind. 4 (1884) 386; FORBES, Nat. Wand. (1885) 513; BAILEY, Queensl. Fl. 4 (1901) 1188; BACK. Ann. J.B.B. Suppl. 3 (1909) 407; ALSTON, Handb. Fl. Ceyl. 6 (1931) 221; GAGNEP. Fl. gén. I.C. 4 (1935) 610.—Fig. 2.**

Erect rank *herb*, frequently widely branched,  $1\frac{1}{2}$ – $1\frac{1}{2}$  m high. Stem subterete, thick, fistular. *Leaves* broadly ovate from a cordate base, with a triangular apex, repand-dentate, herbaceous, pale green, 15–30 by 15–22 cm; petiole thick, fistular, often tinged with purple, 12–25 cm. *Racemes* by the development of a branch in each of the highest leaf-axils often seemingly in bifurcations of the stem, erect, 5–13 cm, not very dense. *Flowers* not very many. Bracts and bracteoles pale pink; bracts clawed,  $1\frac{1}{2}$ – $3\frac{1}{2}$  cm long; their blade oval or oval-obovate, 1–2 cm wide, distinctly veined. Pedicels  $1$ – $2\frac{1}{2}$  cm. Bracteoles at the calyx-base during anthesis still present, ovate-oblong,  $1\frac{1}{2}$ – $2\frac{1}{4}$  cm long. Calyx yellowish white or greenish white,  $1\frac{1}{2}$ –2 cm long, falling off after anthesis. *Corolla* totalling

$5\frac{1}{2}$ – $6\frac{1}{2}$  cm, tube  $3\frac{1}{2}$ – $4\frac{1}{2}$  cm, outside pale pink, on the anterior side within with stalked glands and yellow and purple dots; segments broadly rounded, pink with a dark purple blotch; anterior segment much larger than the others, with a yellow blotch beneath the purple one. Filaments white, glabrous,  $1\frac{1}{2}$ – $1\frac{3}{4}$  cm; lateral staminodes 4–6 mm, posterior one  $1\frac{1}{2}$ –2 mm. Disk broadest on the back, glabrous. Ovary glabrous. Style  $2\frac{1}{2}$ –3 cm, posterior lamella of stigma obtuse, anterior one slightly longer, acute. *Drupe* green, ovoid, with a short upturned beak; endocarp black, very hard,  $\pm$  3 cm long.

Distr. Native of Mexico, locally naturalized in India and Queensland and in *Malaysia*: Java (only surroundings of Batavia) and Lesser Sunda Islands (Sumba, Timor).

Ecol. Lower regions, in waste places, on refuse-dumps, locally sometimes numerous, but, on the whole, scarce, apparently preferring periodically dry regions.

Vern. *Kuku matjan* (tiger's claw), M, *karikuku* (Sumba).

#### Excluded

*Sesamum javanicum* BURM. f. Fl. Ind. (1768) 133, 'habitat in India' according to MERRILL (Philip. J.Sc. 19, 1921, 380) = *Artanema longifolium* (L.) BOLD. (*Scroph.*).



Fig. 1. *Cannabis sativa* L. Flowering twig with ♀ flowers,  $\times \frac{1}{2}$ , the same,  $\times 1\frac{1}{2}$ , fruit,  $\times 6$ .

## CANNABINACEAE (C. A. Backer, Heemstede)

### 1. CANNABIS

LINNÉ, Sp. Pl. (1753) 1027; Gen. Pl. ed. 5 (1754) no 988.

Erect tall annual, usually branched. *Leaves* simple, with 2 free stipules, in the lower part of the stem opposite, in the higher part spirally arranged, long-petioled, palmate, 3–11-foliolate. Flowers ( $\sigma$ )( $\varphi$ ) or mostly ( $\sigma\varphi$ ). *Male flowers* in short, dense cymes, which are united into lax, foliate, terminal panicles, very shortly pedicelled. Tepals 5, free, oblong, membranous, imbricate. Stamens 5, epitepalous; filaments erect and short in bud, linear, with a narrowed apex; anthers comparatively large, basifixed, 2-celled, cells opening longitudinally, rudimentary ovary absent. *Female flowers* solitary in the axil of a small, primary, membranous, entire bract closely enveloping the ovary, each enveloped by a spathaceous, conspicuous, acuminate, secondary bract. Perianth absent. Ovary sessile, 1-celled; style central; stigmas 2, sessile, long, filiform, caducous. Ovule solitary, pendulous. *Achene* closely enveloped by the much enlarged, secondary bract, broadly oval, with a concave rimmed base, much compressed, faintly keeled on the lateral margins; pericarp smooth, hard, crustaceous, easily splitting into two halves; albumen unilateral, scanty, fleshy; embryo large, horseshoe-shaped; cotyledons large; radicle long.

Distr. Monotypic, native of Central Asia, cultivated in tropical Asia, naturalized in N. America.

Uses. See under the species.

**1. *Cannabis sativa* LINNÉ, Sp. Pl. (1753) 1027;** HORSFIELD, Verh. Bat. Gen. 8 (1816) 97; BLUME, Bijdr. (1825) 515; ROXB. Fl. Ind. 3 (1832) 772; ZOLL. Syst. Verz. (1854) 107; MIQ. Fl. Ind. Bat. 1, 2 (1859) 275; Sum. (1860) 99, 171; DC. Prod. 16, 1 (1869) 30; HOOK. f. Fl. Br. Ind. 5 (1888) 487; BOORSMA, Teysm. 3 (1892) 796 *sub var. indica* (LAMK); ASCH. & GR. Syn. 4 (1911) 598; KOORD. Exk. Fl. 2 (1912) 123; MERR. Interpr. (1917) 199; HEYNE, Nutt. Pl. (1927) 580; WALTER in K.L. & S. Leb. Gesch. Bl. Pfl. Mitt.-Eur. 2, 1 (1935) 879; BURK. Dict. (1935) 437; BACK. Bekn. Fl. Jav. em. ed. 6 (1948) fam. 131, p. 1.—*C. indica* [RUMPH. Herb. Amb. 5 (1747) 208, t. 77, f. 1, *et C. i. tertia* L.c. f. 2] LAMK, Enc. 1 (1783) 695.—Fig. 1.

Stem slender, slightly angular, usually 1–1½ m tall, sometimes much taller, rather densely appressed-pubescent when young. Stipules erect, filiform or narrowly subulate,  $\pm 1/2$  cm long. *Leaves* (3–)5–7(–11)-foliolate; upper ones often 1-foliolate. Leaflets sessile, narrowly lanceolate from a narrowed base, long-acuminate, acute, rather coarsely acutely serrate, on the upper surface very scabrid by short stiff hairs inserted on top of a cystolith (very conspicuous in dried leaves), on the lower surface appressed-pubescent and rather densely beset with sessile glands, 6–14 cm by 3–15 mm.  $\sigma$ : *Tepals* oblong, greenish white with pellucid white

margins, finely appressed-pubescent,  $\pm 5$  mm long. Anthers yellow, 3–4 mm.  $\varphi$ : *Enveloping bract* on the back rather densely clothed with patent short, thick, glandular hairs, darkgreen, rather small during anthesis, afterwards much enlarged. Stigmas up to ½ cm long. Fruiting bract much contracted above the broad base, in the upper half with in-rolled margins, up to ¾ cm long. *Fruit* smooth, shining, yellowish or brown,  $\pm 4$ –5 mm long. Seed containing oil.

Distr. Native of Central Asia, cultivated either as a fibreplant or as a narcotic in many other countries.

Use. In Malaysia sometimes cultivated on a small scale, exclusively for its leaves which are smoked as an intoxicant. The narcotic is the dried prepared tops of the female plant taken when the seeds are yet undeveloped. This drug is called *hashish*. Before the war it was forbidden to cultivate hemp in the Netherlands Indies, and the drug was, mostly with ripe fruit, often secretly smuggled into the country.

Vern. *Hennep*, D, *genja* (Sum.), *ginjé djawa*, J, *hemp plant*, E.

Note. Plant of very early cultivation, recorded for Java already more than 900 years ago by the Chinese. In Malaysia the  $\sigma$  plant is not cultivated, and the  $\varphi$  always possesses some  $\sigma$  flowers at the base of the  $\varphi$  inflorescences.





Fig. 1. *Azima sarmentosa* (BL.) B.&H. Female twig with fruits, part of male inflorescence,  $\times \frac{1}{2}$ , single male flower,  $\times 8$ . Courtesy Pasuruan Exp. Station.

## SALVADORACEAE<sup>1</sup> (C. A. Backer, Heemstede)

### 1. AZIMA

LAMK, Enc. 1 (1783) 343.—*Actegeton* BL. Bijdr. (1826) 1144.—*Monetia* subg. *Azima* BAILL. *Adansonia* 9 (1870) 289.

Much-branched, erect or rambling shrubs, armed with axillary spines. *Leaves* opposite, often with rudimentary stipules, simple, quite entire. *Flowers* in axillary or terminal racemes or panicles, or in axillary fascicles, unisexual (monoecious or dioecious) or sometimes partly bisexual, actinomorphic, 4-merous. Calyx campanulate, 4-lobed or 2–4-partite. Petals 4, free, imbricate in bud, oblong or lanceolate. Disk absent. ♂: Stamens 4, alternating with the petals, longer than the corolla, in ♀ reduced to staminodes; filaments slender, free or connate at the base; anthers oval, cells 2, back to back, opening longitudinally; no rudimentary ovary. ♀: Staminodes 4, not exceeding the corolla, anthers barren. Ovary superior, globose, 2-celled or imperfectly 4-celled; ovules 4, erect from the base; style short or almost absent; stigma subsessile, large, deeply bifid. ♀ like ♀, but with 4 perfect stamens. *Berry* globose; with a thin endocarp. Seeds 1–3, erect, flat, orbicular, exalbuminous; cotyledons cordate, thick; testa coriaceous.

Distr. Few spp. in tropical and subtropical Africa and tropical Asia, one extending into *West Malaysia*.

Ecol. Like most members of the family the Malaysian sp. occurs in hot, dry regions.

**1. *Azima sarmentosa* (BL.) B. & H. Gen. Pl. 2 (1876) 681; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1882) 620; O.K. Rev. Gen. 2 (1891) 412; BOERL. Handl. 2, 2 (1899) 338; KOORD. Exk. Fl. 3 (1912) 55; MERR. Fl. Man. (1912) 366; Sp. Blanc. (1918) 305; En. Philip. 3 (1923) 309; BACK. Onkr. Suiker. (1931) 483, t. 458; DOP. Fl. Gén. I.C. 3 (1933) 1084, f. 124; BURK. Dict. 1 (1935) 276; SLEUM. in E. & P. ed. 2, 20b (1942) 237.—*Actegeton sarmentosum* BL. Bijdr. (1826) 1144; SPAN. Linnaea 15 (1841) 187; A. DC. Prod. 17 (1873) 30.—*Azima nova* BLANCO, Fl. Filip. (1837) 68; ed. 2 (1845) 49; ed. 3, 1 (1877) 91.—*Monetia barlerioides* (non L'HÉR.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 596.—*Monetia sarmentosa* BAILL. *Adansonia* 9 (1870) 289, t. 10.—**Fig. 1.****

Erect glabrous shrub with often long, rambling or drooping branches, 2–4 m long; leaf-axils often with 1–2 patent thin, straight, very sharp, 2–16 mm long spines which easily break off. Stipules at the base of each petiole 2, minute subulate, subpersistent. *Leaves* variable as to shape, ovate, elliptic, oblong, oval, suborbicular or obovate from an acute, obtuse or rounded base, abruptly tipped with a small triangular not or hardly spinous point, thinly coriaceous, flexible with a strongish midrib and thin lateral nerves and veins, shining, 2–6½ cm by 1½–6½ cm; petiole 3–7 mm. *Flowers* in racemes or panicles of 1–25 cm long; lower of these axillary, higher often united in a terminal panicle with wide-divaricating branches; rachises thin. Distribution of sexes various; some specimens ♂, others ♀ or (♂♀); the (♂♀) ones sometimes with a few ♀ flowers. Bracts persistent, patent, elongated-triangular, very acute, not spiny, ¾–2½ mm long. Calyx,

corolla, staminodes of ♀ and stamens of ♂ persisten after anthesis. ♂ *Flowers* rather crowded, sessile or subsessile. Calyx more or less deeply divided into obtuse erect segments, 2–2½ mm long. Petals somewhat exceeding the calyx, oblong, entire or at the apex slightly dentate-serrate, green, 2–2½ mm long. Filaments exceeding corolla; anthers oblong, 1¼–1½ mm. ♀ *Flowers* on 1–8 mm long pedicels. Calyx 1¼–1½ mm long. Corolla as in ♂ but only 1½–2 mm long. Staminodes not exceeding the corolla; barren anthers sagittate. Ovary imperfectly 4-celled; stigmatic arms broad, widely divaricating. ♀ like ♀, but with perfect stamens. *Berry* globose, white, ± 6 mm diam. Seeds 2–3, less often 1.

Distr. Continental SE. Asia, in *Malaysia* not yet recorded from Sumatra, the Malay Peninsula, Borneo, the Moluccas, and New Guinea.

Ecol. In northern Java in dry coastal regions from the plains up to 160 m, in periodically very dry localities: thickets, hedges, field- and forest-borders, locally not rarely rather numerous.

Vern. *Papadjaran*, S, *bulangan*, Md, *añgañgri* (Ilk.).

Notes. The crushed branches emit an offensive smell reminding of that of the bruised leaves of *Diplotaxis tenuifolia* DC.

*Monetia barlerioides* L'HÉR. = *Azima tetra-cantha* LAMK, with which MIQUEL, F.-VILLAR, &c. confounded this species, differs i.a. by its stiff erect habit, narrower, more rigid, strongly spine-tipped leaves with a narrowed base and the often 4-nate and on the whole, stronger axillary spines. Acc. to BURKILL it has been introduced in Penang (Dict. 1935, 276).

(1) Palaeotropical and subtropical, small family, in *Malaysia* only represented by one genus.

# PUNICACEAE<sup>1</sup> (C. A. Backer, Heemstede)

## PUNICA

LINNÉ, Sp.Pl. (1753) 472; Gen. Pl. ed. 5 (1754) no 544.

Shrubs or small trees, usually spiny. *Leaves* opposite, alternate or fascicled, exstipulate, simple, entire, penninerved, small. *Flowers* terminal and subterminal, sessile or nearly so, rather large, ♂, actinomorphic. Calyx thickly coriaceous, coloured, gamophyllous; tube campanulate-urceolate, adnate to the ovary and produced above it, inside with an annular thickening; segments 5–9, valvate in bud, ovate-triangular, acute, persistent. *Petals* the same number as calyx-lobes and alternating with them, imbricate and strongly crumpled in bud, obovate, deciduous. Stamens very numerous, inserted on the annular thickening of the calyx, deciduous, filaments incurved in bud, filiform, free; anthers dorsifixed, 2-celled; cells bursting longitudinally. *Ovary* entirely inferior or free at the top; cells several in 2–3 superposed rows, exceptionally 1-seriate; ovules numerous; those of the lower cells axile, of the upper parietal; style 1, robust, with a thickened base; stigma capitate. *Berry* large, subglobose, crowned by the unaltered calyx-segments, thick-walled, finally bursting irregularly, entirely filled up by the seeds. Seeds very numerous; outer layer of testa thick, fleshy-juicy; inner layer horny; endosperm none; cotyledons convolute.

Distr. Two spp. viz *P. protopunica* BALF. f. confined to Socotra, and *P. granatum* L., a plant of very ancient cultivation in S. Europe, N. Africa, the Orient, tropical Asia, Malaysia, and China. Also introduced in the New World.

**1. *Punica granatum*** LINNÉ, Sp. Pl. (1753) 472; BURM. f. Fl. Ind. (1768) 116; BL. Bijdr. (1826) 1098; DC. Prod. 3 (1828) 3; BLANCO, Fl. Fil. (1837) 422; ed. 2 (1845) 295; ed. 3, 2 (1878) 184, t. 211; SPAN. Linnaea 15 (1841) 205; MIQ. Fl. Ind. Bat. 1, 1 (1855) 495; Sum. (1860) 120; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1879) 581; DC. Orig. Pl. cult. (1886) 191; KOORD. Minah. (1898) 470; COOK, J. Wash. Ac. Sc. 2 (1912) 434; KOORD. Exk. Fl. 2 (1912) 664; MERR. Fl. Man. (1912) 344; Interpr. Herb. Amb. (1917) 384; Sp. Blanc. (1918) 282; En. Philip. 3 (1923) 141; HEYNE, Nutt. Pl. (1927) 1158; OCHSE & BAKH. v. D. BR. Fruit and Fruit Culture (1931) 105, t. 41; C. R. Ac. Sci., U.R.S.S. 3 (1935) 403; BURK. Dict. 2 (1935) 1839; CAIRNS, J. Bomb. Nat. Hist. Soc. 42 (1940) 13–37.—BACK. Bekn. Fl. Jav. em. ed. 4 (1942) fam. 74, p. 1; STEEN. Fl. Sch. Indon. (1949) 293.—*Malum granatum* RUMPH. Herb. Amb. 2 (1741) 94, t. 24, f. 1.—*P. nana* LINNÉ, Sp. Pl. ed. 2 (1762/63) 676; DC. Prod. 3 (1828) 3.—Fig. 1.

Shrub or small crooked tree,  $\frac{1}{2}$ –5 m high, often much branched from near the base; branches often ending in a spine, moreover frequently with axillary leafbearing or leafless spines; when very young tetragonous or narrowly tetrapterous, afterwards obtusangular or subterete, glabrous. *Leaves* mostly opposite, oblong-lanceolate from an acute or less often rather obtuse base, acute, obtuse or emarginate, entire, firmly herbaceous, shining above, 1–9 by  $\frac{1}{2}$ –2 $\frac{1}{2}$  cm; midrib much prominent beneath;

lateral nerves rather numerous, erecto-patent or ascending, thin. *Flowers* 1–5 at the top of the branchlets; 1 of them terminal; the others solitary in the highest leaf-axils, odourless. Calyx (receptacle included) 2–3 cm high, red or pale-yellow; segments erecto-patent or slightly recurved, thick, at the apex on the back with a yellowish green gland, along the margin densely and shortly papillose,  $\frac{3}{4}$ –1 $\frac{1}{4}$  cm long. *Petals* erecto-patent or patent, with a rounded or very obtuse apex, flaming red or white and then turning brown when fading,  $1\frac{1}{2}$ –3 by 1–2 cm. Stamens glabrous,  $\frac{1}{2}$ –1 cm long. Style surpassing the stamens,  $\frac{3}{4}$ –1 $\frac{1}{4}$  cm. *Berry* 5–12 cm diam., variable as to colour, yellowish green, white, reddish brown or rarely blackish violet. Seeds obtusangular, red, pink or yellowish white.

Distr. Probably originating from Persia and some adjoining countries, from there introduced into S. Europe, N. Africa (Carthago; hence the name *poma punica*), the Orient, SE. Asia, Malaysia, and China. In the Levant the plant has run wild.

Ecol. Cultivated as a fruit-tree or for medicinal purposes throughout the lower regions of Malaysia, 1–1000 m, always on a very small scale and nowhere naturalized. The fruits produced in Malaysia are of poor quality. The farther from Persia the more inferior, on an average, are the fruit (BURLING). A dwarfed form (*P. nana* L.) and a double-flowered form are cultivated as ornamental plants, often in pots.

(1) I do not agree with GRIFFITH (Posth. Pap. 2, 1849, p. iii, x) and HALLIER f. (Med. Rijksherb. 35, 1918, 17) who combined *Sonneratiaceae* (and *Crypteroniaceae*) with *Punica* in one family.

Uses. The root-bark is a highly valued specific for tape-worm.

Vern. In many languages *dalima* or *dělima*,

moreover: *gangsalan*, J, and several local names.

Note. Fl. Jan.-Dec., mostly sparingly.

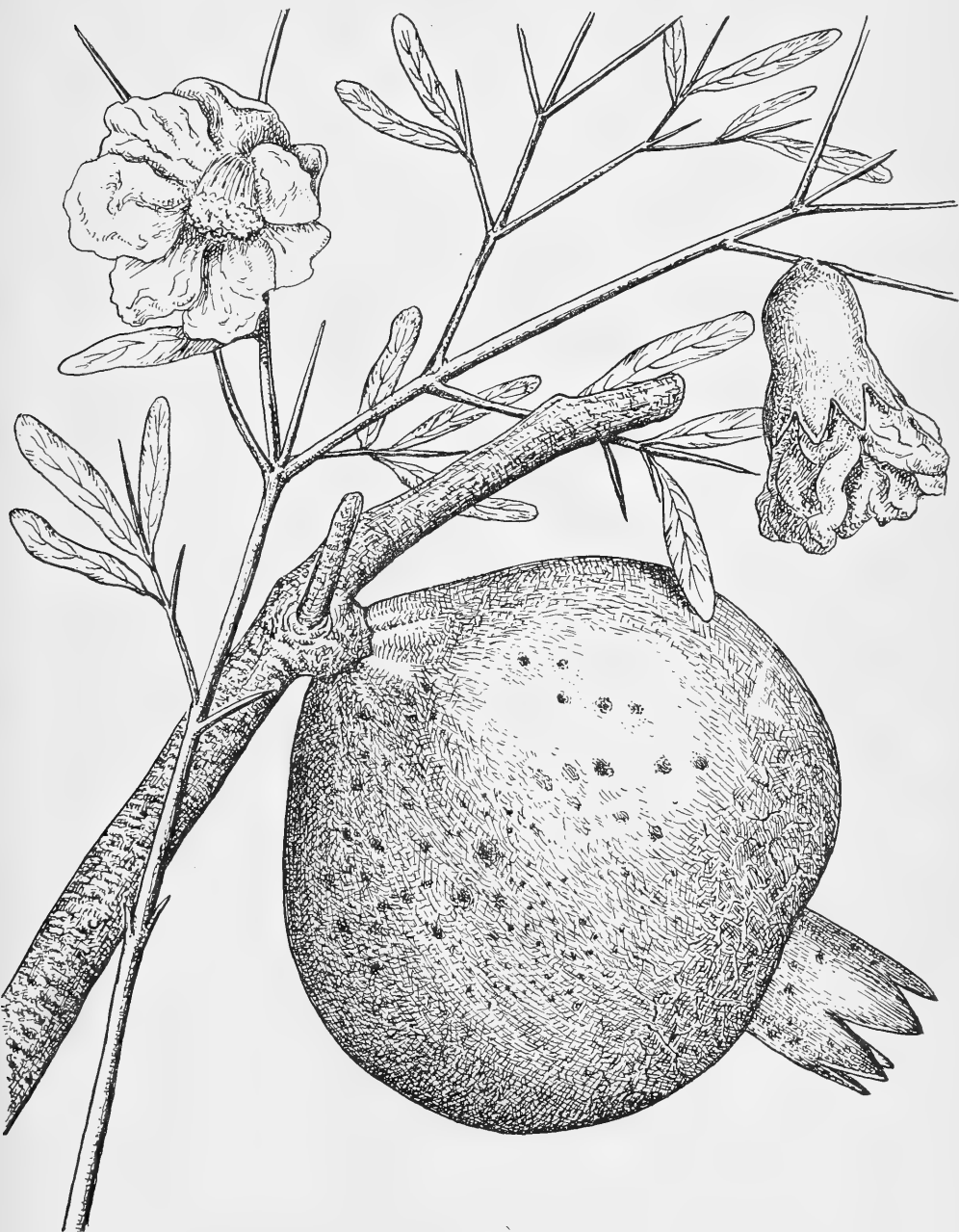


Fig. 1. *Punica granatum* L. Flowering and fruiting twigs, nat. size (after OCHSE).



Fig. 1. *Rivinia humilis* L. Habit, nat. size, *a*, bud, *b*, flower, *c*-*d*, stamen, *e*, young fruit, *f*, fruit, *g*, seed  
 (a-b  $\times 4$ , c-e  $\times 5$ , f-g  $\times 2\frac{1}{2}$ ).

## PHYTOLACCACEAE (C. A. Backer, Heemstede)

Herbs, shrubs or (not in Malaysia) trees. *Leaves* alternate, simple, entire; stipules minute or absent. *Flowers* in terminal, axillary or lateral racemes, bracteate and bibracteolate, ♂ or unisexual, actinomorphic or zygomorphic, mostly (so in the Malaysian species) monochlamydeous. *Tepals* 4–5, herbaceous or membranaceous, free, imbricate in bud, coloured during and often also after anthesis, equal or unequal, persistent. *Stamens* 3 to many, usually inserted on a hypogynous disk, either regularly or irregularly arranged, 1–2-seriate; those of the only or outer series more or less alternating with the tepals; filaments slender, free, persistent; anthers dorsi- or basifixed, dehiscing longitudinally. Ovary superior, composed of 1 or more carpels; these either free or laterally connate. Styles as many as carpels, short, or none, free. Ovules solitary in each carpel, basal. *Fruit* of 1 or more carpels, juicy or dry. Seed erect; embryo large, peripheric, enclosing the endosperm.

Distr. Genera upwards of 20, mostly inhabitants of the tropics of both hemispheres, mainly of America. In Malaysia 3 herbaceous or subshrubby genera, all introduced from tropical America.

Ecol. The Malaysian species inhabit anthropogenic localities: open jungles, forest-borders, roadsides, waste places.

Uses. None of any importance.

### KEY TO THE GENERA

1. Tepals in all flowers 5. Styles 5–10. Fruit a juicy, 5–10-seeded, black or dark red berry **3. Phytolacca**
1. Tepals in all flowers 4. Style 1 or none. Fruit 1-seeded.
  2. Flowers actinomorphic. Ovary glabrous. Style short but distinct. Raceme erect 4–10 cm long. Fruit a juicy unarmed berry, bright red. Bruised leaves not smelling of onions . . . . . **1. Rivinia**
  2. Flowers zygomorphic. Ovary densely pubescent. Style none; stigma consisting of many hairs. Raceme nodding at the top, usually more than 10 cm long when adult. Fruit dry with 4 apical, reflexed, very sharp spines. Bruised leaves smelling of onions . . . . . **2. Petiveria**

### 1. RIVINIA

LINNÉ, Sp.Pl. (1753) 121; Gen. Pl. ed. 5 (1754) no 150.

Erect slender herbs, often woody at the base. *Leaves* on longish petioles, exstipulate, ovate-oblong or ovate-lanceolate, long-acuminate, acute, herbaceous. *Flowers* ♂, in terminal and pseudolateral, erect or erecto-patent, often somewhat flexuous, rather lax racemes. Pedicels slender, minutely bibracteolate above the middle or near the top. *Tepals* 4, subequal, during anthesis patent or  $\pm$  reflexed, white or pinkish, after anthesis slightly accrescent, turning green, at first conniving, finally often spreading or reflexed. *Stamens* 4, alternating with the tepals, shorter than these; anthers dorsifixed, bifid at both ends, glabrous. Ovary unicarpellate, subglobose, glabrous. Style short, decurved after anthesis; stigma capitate. *Fruit* a globose, 1-seeded berry. Seed lenticular, glabrous or shortly hairy.

Distr. Species 3<sup>1</sup>, closely allied, native in tropical America; one of these naturalized in Madagascar, Réunion, Ceylon, tropical SE. Asia and Malaysia.

**1. Rivinia humilis** LINNÉ, Sp. Pl. (1753) 121; LAMK, Ill. (1791) t. 81, f. 1; Bot. Mag. (1816) t. 1781; MOQ. in DC. Prod. 13, 2 (1849) 13; EDELING, Nat. Tijds. N.I. 31 (1870) 336; SCHMIDT in MART. Fl. Bras. 14, 2 (1872) 336; WALTER, Pfl. R. 39 (1909) 102 incl. *var. glabra* (L.) WALT.; BACK. Ann. J.B.B. Suppl. 3 (1909) 412; KOORD. Exk. Fl. 2 (1912) 205; MERR. Philip. J.Sc. 11 (1916) Bot. 270, incl. *var. orientalis* (MOQ.) H. WALT.; MERR. En. Philip. 2 (1923) 135;

WILSON, Addisonia 12 (1927) 51, 1 pl.; FURTADO, Gard. Bull. S. S. 4 (1929) 415; JOCHEMS, Trop. Natuur 21 (1932) 149, f. 6; BURK. Dict. 2 (1935) 1913; JOSHI, J. Ind. Bot. Soc. 15 (1936) 91 (embr.); BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 61, p. 2.—*Rivinia laevis* LINNÉ, Mant. 1 (1767) 41; F.-VILL. Nov. App. (1880) 172; CERON, Cat. Pl. Herb. Manila (1882) 137.—*Rivinia orientalis* MOQ. in DC. Prod. 13, 2 (1849) 12; ZOLL. Syst. Verz. (1854) 142;

(1) According to HEIMERL in E. & P. ed. 2, 16c (1934) 147, the genus consists of one variable species only.

MOQ. Fl. Ind. Bat. 1, 1 (1858) 1014.—*Tithonia humilis* O.K. Rev. Gen. 2 (1891) 552.—Fig. 1.

Erect herb, not rarely with a woody base, usually repeatedly branched, 40–100 cm, rarely up to 2 m high; stem in the upper part shortly patently pubescent. *Leaves* rather remote, ovate-oblong or ovate-lanceolate, from a very obtuse, rounded or subcordate base, long-acuminate, acute, glabrous above, shortly pubescent on midrib beneath, 4–12 by  $1\frac{1}{2}$ –4 cm; petiole shortly patently pubescent, 1– $3\frac{1}{2}$  cm. *Racemes* erect or erecto-patent, thinly patently short-pubescent, 4–10 cm long (peduncle included),  $\infty$ -flowered. Pedicel erecto-patent or widely patent, during anthesis 2–3 mm long, afterwards 3–4 mm. *Tepals* during anthesis white or pinkish, 2– $2\frac{1}{2}$  mm long, in fruit 3– $3\frac{1}{2}$  mm. *Berry* bright red,  $3\frac{1}{2}$ –4 mm diam. Seeds moderately densely clothed with patent, short hairs,  $\pm$  2 mm diam.

Distr. Native in tropical America, naturalized in Ceylon, Further India &c., in *Malaysia*: Singapore, N. Sumatra, Java, Madura, Philippines, etc. Introduced in Java more than a century ago, at present naturalized throughout the island, 1–450 m.

Ecol. Slightly shaded localities, under hedges, at the foot of walls, open jungles, campong borders, waste places, locally often rather numerous, but not gregarious.

Vern. *Coral-berry*, E.

Note. In the Malay Peninsula the root is said, but not proved, to be very poisonous; a child in Calcutta was poisoned by the berries, the case not being fatal (BURKILL, *l.c.*). Cattle eat the herbage in Australia; it imparts an unpleasant smell and taste to the milk; their excreta also smell of it (C. T. WHITE, Queensl. Agr. J. new ser. 25, 1926, 274).

## 2. PETIVERIA

LINNÉ, Sp.Pl. (1753) 342; Gen. Pl. ed. 5 (1754) no 417.

Erect undershrubs; stipules subaxillary, subulate, minute. *Leaves* on short or medium-sized petioles, ovate-elliptic-lanceolate, smelling of onions when bruised. *Flowers*  $\bar{\sigma}$ , zygomorphic, small. *Racemes* terminal and axillary, erect or nodding at the top. Pedicels very short, bearing 2 minute bracteoles. *Tepals* 4, oblong-linear, during anthesis spreading and yellowish white, afterwards erect, accrescent, turning green, indurating. Stamens 4–8 on the base of the perianth and shorter than this, unequal; anthers dorsifixed, linear, with a deeply bifid apex and a slightly 2-lobed base. Ovary unicarpellate, oblong, densely pubescent, on the top with 4 or 6 deflexed bristles which afterwards change into short, sharp spines, 1-celled. Style absent; stigma lateral on the ventral upper half of the ovary, consisting of many longish hairs. *Fruit* exserted from the enclosing perianth, narrowly cuneiform, compressed, dry, indehiscent; pericarp coriaceous, adhering to the seed. Seed linear.

Distr. Species 1 or 2, native in the warmer regions of America, one on a very small scale naturalized in Java.

1. *Petiveria alliacea* LINNÉ, Sp. Pl. (1753) 342; GAERTN. Fruct. 1 (1788) 363, t. 75; MOQ. in DC. Prod. 13, 2 (1849) 9; SCHMIDT in MART. Fl. Bras. 14, 2 (1872) 332; WALTER, Pfl. R. 39 (1909) 118; BACKER, Bekn. Fl. Java em. ed. 4 (1942) fam. 61, p. 2.

Erect,  $\frac{1}{2}$ – $1\frac{1}{2}$  m high; stem thin, hairy in the upper part. *Leaves* elliptic-oblong or slightly obovate, from an acute base, with a narrowed or acuminate, acute, obtuse or rounded apex, wavy, pubescent on the main nerves above, glabrous beneath, 6–17 cm by  $2\frac{1}{2}$ – $6\frac{1}{2}$  cm; petiole  $\frac{1}{2}$ – $1\frac{1}{2}$  cm. *Racemes* spiciform, often nodding at the apex, rather lax, 10–40 cm long. Bracts ovate, acutely acuminate. Pedicels  $\frac{1}{2}$ –1 mm. *Perianth* during

anthesis 3–4 mm long, afterwards up to 6 mm. Stamens 6–8, erect. *Fruit*-spines 4,  $\pm$  3 mm long.

Distr. Native of the warmer parts of America, established and reproducing itself by seeds in a few localities near Bogor (W. Java), outside the Botanic Garden from which it is probably an escape, at  $\pm$  240 m alt.

Ecol. Under hedges.

Use. When the food of cattle contains *Petiveria* it imparts an unpleasant smell and taste to milk and meat.

Vern. *Guinea-hen weed*, *gully root*, E.

Note. Though the fruits readily adhere to passers-by the plant is still far from common.

## 3. PHYTOLACCA

LINNÉ, Sp.Pl. (1753) 441; Gen. Pl. ed. 5 (1754) no 521.

Erect (or scandent) herbs (or shrubs), glabrous barring the papillate or shortly hairy main-axis of inflorescence; stem often angular. *Leaves* exstipulate, ovate-oblong-lanceolate, acute at both ends, herbaceous. *Flowers*  $\bar{\sigma}$  [or ( $\bar{\sigma}$ ) ( $\bar{\sigma}$ )] in terminal

or pseudolateral, often long, sometimes spiciform, erect racemes; pedicels shortish or short, sometimes very short. *Perianth* herbaceous, coloured, 5-partite; segments spreading during anthesis, afterwards often more or less reflexed, equal or slightly unequal, ovate, oval or obovate, afterwards often dark red. *Stamens* (6-)7-22(-33), 1-2-seriate, more or less irregularly arranged; those of the inner or only series inserted on the outer margin of the disk; those of the outer series on the under-surface of the disk; filaments filiform-subulate; anthers dorsifixed, bilobed at both ends. Carpels 5-10(-16), whorled, laterally connate throughout their length into a depressed globose ovary. Styles terminal on the inner angle of the carpels, erect or recurved, subulate, short. *Fruit* baccate, depressed globose, longitudinally 5-10-furrowed. Seeds oval from an inequilateral base, strongly laterally compressed, shining black.

Distr. Species ca 25, tropical and subtropical, mostly in America, a few in Africa and Asia, several species in Europe frequently cultivated as ornamentals. In *Malaysia* only 3 introduced American species. Ecol. Along road-sides, forest- and field-borders, open jungles, waste places.

Notes. Besides the *spp.* mentioned below, BUYSMAN (Flora 107, 1915, 221) mentions to have cultivated the shrubby *Ph. dioica* L. at Nongkodjadar in E. Java; it did not flower.

*Phytolacca acinosa* ROXB., a plant with free ripe carpels, is indigenous to Japan, China and the Himalaya. It has sometimes wrongly been credited (e.g. by KOORDERS, Exk. Fl. Java) to Java where it does not occur.

#### KEY TO THE SPECIES

1. Stamens in all flowers, also in the lowermost ones, 7-9, all of them inserted on the outer margin of the disk . . . . . 1. *Ph. octandra*
1. Stamens, at least in the middle and lowermost flowers 10-22, partly inserted on the outer margin of the disk, partly on its underside.
  2. Pedicels during anthesis  $1\frac{1}{2}$ -2 mm, under the adult fruit 1-2 $\frac{1}{2}$  mm . . . . . 2. *Ph. icosandra*
  2. Pedicels during anthesis 2-4 mm, under the adult fruit 4-7 mm . . . . . 3. *Ph. purpurascens*

1. *Phytolacca octandra* LINNÉ, Sp. Pl. ed. 2 (1763) 631; BURM. f. Fl. Ind. (1768) 107; GRISEB. Fl. Br. W. Ind. Isl. (1864) 58; BTH. Fl. Austr. 5 (1870) 143; TRIMEN, Fl. Ceylon 3 (1895) 410; BAILEY, Queensl. Fl. 4 (1901) 1267; WALTER, Pfl. R. 39 (1909) 58; BACKER, Bekn. Fl. Java. em. ed. 4 (1942) fam. 61, p. 3.

Branched herb, 40-60 cm high; stem angular. *Leaves* oblong-lanceolate or ovate-lanceolate from an acute base, gradually narrowed towards the apex or acuminate, 6-15 by 1 $\frac{3}{4}$ -6 cm; petiole 1-3 cm. Adult raceme 8-25 cm long ( $\frac{3}{4}$ -3 cm peduncle included), dense; rachis more or less densely papillate or almost smooth. Pedicels during anthesis 1-2 mm, under adult fruit 2-3 mm. *Tepals* ovate, varying from rather acute to rather obtuse, during anthesis pink, 2 $\frac{1}{2}$ -3 mm long, under the fruit 3-4 mm. Styles 7-9, usually 8. *Fruit* with 8(7-9) longitudinal furrows. Seeds  $\pm$  2 mm long.

Distr. Native of tropical America, extending from Mexico to Columbia, elsewhere locally naturalized, in *Malaysia* in N. Sumatra and W. Java, very local;  $\pm$  1700 m above sea-level.

Ecol. Road- and water-sides, field-borders, waste places.

Uses. Young sprouts and leaves can be used as a vegetable.

2. *Phytolacca icosandra* LINNÉ, Sp. Pl. (1753) 60; PERS./Syn. 1 (1805) 523; WALTER, Pfl. R. 39 (1909) 60; BACKER, Bekn. Fl. Java, em. ed. 4 (1912) fam. 61, p. 3.—*Ph. decandra* (non L.) BACKER, Bull.

J.B.B. II, 12 (1913) 26; BUYSMAN, Flora 107 (1915) 221.

Erect herb, 50-100 cm high; stem angular. *Leaves* ovate-oblong, oblong or lanceolate, 6-20 by 1 $\frac{1}{2}$ -9 cm; petiole 2-6 cm. Racemes erect or suberect, 12-35 cm long when adult (including 5-10 cm long peduncle), rather dense, sometimes very dense; rachis of raceme red, rather densely patently papillose. *Tepals* ovate-oval-obovate, during anthesis pink, 3-4 mm long, under the ripe fruit dark red, 4-5 mm. Stamens, at least in the middle and lower flowers, 10-22, partly on the margin of the disk, partly on the underside of it; in the highest flowers sometimes not more than 7-9, on the margin of the disk. Styles 7-10. *Fruit* 7-8 mm diam., faintly lobed. Seeds  $\pm$  2 $\frac{1}{2}$  mm.

Distr. Native of tropical America, in *Malaysia*: W. & E. Java, 300-1200 m, locally established.

Ecol. Forest-borders, light forests, road-sides, waste places, locally sometimes very numerous but, on the whole, rare.

Note. The ripe berries are greedily devoured by some species of birds.

3. *Phytolacca purpurascens* A.Br. & BOUCHÉ in Index Sem. Hort. Berol. (1851) App. 13; Linnaea 25 (1852) 297; WALTER, Pfl. R. 39 (1909) 59; BACKER, Bekn. Fl. Java, em. ed. 4 (1942) fam. 61, p. 4.

Erect herb,  $\frac{3}{4}$ -1 $\frac{1}{2}$  m high; stems angular. Adult racemes not very dense, 20-35 cm long (5-13 cm long peduncle included); rachis sparingly short



papillate. Stamens 12–19. Styles 6–8, rarely 5. For the rest like *Ph. icosandra*.

Distr. Native of Central America, in *Malaysia*: Java. Naturalized here and there, 150–2000 m.

Ecol. Forest-borders, waste places, *Imperata*-fields, abandoned agricultural fields; tea- and *Cinchona*-plantations.

Note. Most reluctantly I have kept up *Ph. purpurascens* as a separate species. In my opinion it is

simply one of the many forms of *Ph. icosandra*, into which it passes by numerous intergrades; it cannot even justly claim varietal rank.

#### Excluded

*Adenogramma oppositifolia* HASSK. Flora 34 (1851, 754 = *Alternanthera sessilis* (L.) R.BR.; cf. BACKER) Fl. Mal. I, 4<sup>2</sup> (1949) 92.

## SPARGANIACEAE<sup>1</sup> (C. A. Backer, Heemstede)

### 1. SPARGANIUM

LINNÉ, Sp.Pl. (1753) 971; Gen. Pl. ed. 2 (1754) no 925.

Aquatic often rather large perennial herbs with creeping, subterranean stolons. Stem simple or branched, leafy at the base, stiff or flaccid, erect or floating, bearing a terminal spike or panicle. *Leaves* long, linear from a sheathing base. *Flowers* (♂♀), crowded in separate globose clusters; lower clusters ♀, in or above the axil of a leafy bract, stalked or sessile; higher clusters ♂, bractless or with a small bract. ♂: *Perianth* actinomorphic, choriphyllous. *Tepals* 3(-6), spathulate. *Stamens* 3(-6); filaments free or connate at the base; anthers basifixed, oblong; pollen globose. ♀: *Tepals* as in ♂ but larger. *Ovary* 1, exceptionally 2, sessile with a narrow base, unilocular; *ovule* 1, pendulous; *style* 1, usually simple, rarely forked; *stigma* unilateral, short. *Fruits* densely crowded, sessile with a narrow base, crowned by the style, indehiscent; *exocarp* spongy, *endocarp* hard; *testa* thin; *embryo* in the middle of the mealy endosperm.

*Distr.* Temperate and colder regions of the N. hemisphere, crossing the tropics in Malaysia over the mountains towards Australia and New Zealand. About 15 species have been distinguished, in *Malaysia* only one *sp.* occurs.

*Ecol.* Usually in shallow stagnant or slowly moving fresh water. Flowers anemophilous.

**1. *Sparganium simplex*** HUDS. Fl. Angl. ed. 2 (1778) 401; KOCH, Syn. ed. 2 (1843/45) 1786; HOOK. f. Fl. Br. Ind. 6 (1893) 490; GRAEBN. Pfl. R. 4 (1900) 16; ASCH. & GR. Syn. Mitt.-Eur. Fl. ed. 2, 1 (1912) 433; STEEN. Bull. J.B.B. III, 13 (1936) 254.

*f. simplex*.—*f. typica* ASCH. & GR. Syn. Mitt.-Eur. Fl. ed. 1, 1 (1897) 434.

Perennial, erect, glabrous, aquatic herb, 40–80 cm high. Basal *leaves* distichous, erect, above the wide basal sheathing part more or less contracted (sometimes stalk-like), above the more or less trigonous contraction broadened, narrowly linear

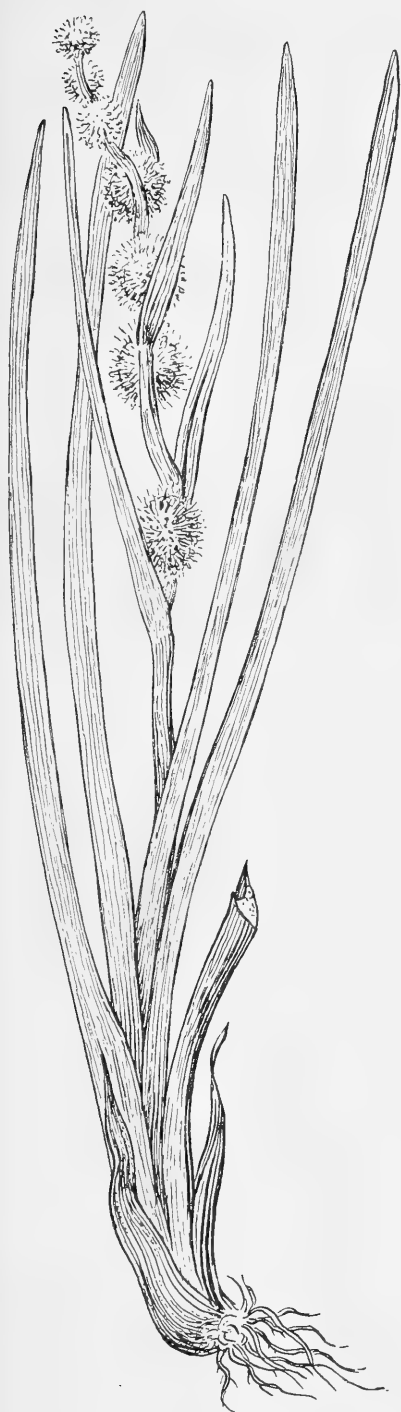


Fig. 1. *Sparganium simplex* HUDS., nat. size.

(1) The family consists of one genus only.

with a tapering rather obtuse apex, smooth-margined, rather thick and hard, in a living state distinctly keeled below, up to 80 cm long (basal sheath included),  $\frac{3}{4}$ – $1\frac{1}{2}$  cm wide, rather densely and finely longitudinally nerved, between the nerves rather closely horizontally cross-veined; higher cauline leaves and bracts linear from a stem-clasping base. Inflorescence erect, long-stalked, up to 70 cm long (stalk included), not surpassing the leaves. ♂ *Flower-clusters* (upper part of inflorescence) 4–8, bractless or with a small bract, rather close together, many-flowered. Tepals often 3, thin with a thickened midrib,  $\pm 2\frac{1}{4}$  mm long. Stamens 3 or more, greatly exceeding the perianth; filaments very thin, 4–5 mm long; anthers oblong,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm. ♂ Flowers falling off after anthesis, leaving the rachis bare. ♀ *Clusters* 2–6, remote, usually inserted far above the axil of the leaf-like, linear, 6–25 cm long bract, very many-flowered, very dense, during anthesis  $1\frac{1}{4}$  cm diam., in fruit up to  $2\frac{1}{2}$  cm

diam. Tepals 3 or more, spatulate with a subrhomboid apex, strongly 1-nerved, 5–6 mm long, persistent after anthesis. Style (short stigma included)  $\pm 4$  mm. *Fruits* densely crowded, squarrose, shortly (up to 2 mm) stalked, oblong or ovoid-oblong, 5–6 mm long (including stalk, but not computing the often curved style); endocarp rather thick, usually 1-celled.

Distr. Covering the area of the genus, in *Malaysia* very rare: Central Sumatra, New Guinea (Arfak and Tafa Mts).

Ecol. On shores of lakes and streams in shady forests, at an altitude of 1500–2400 m, sometimes gregarious.

Vern. *Kleine egelskop*, D, *simple bur-reed*, E.

Note. Rather variable species. The material of the Arfak Mts in W. New Guinea is sterile (cf. HATUSIMA, Tokyo Bot. Mag. 56, 1942, 421) but in all probability represents this species.

## TURNERACEAE (C. A. Backer, Heemstede)

Erect or ascending herbs, annual or perennial, sometimes woody at the base. Leaves alternate, stipulate or not, simple, petioled, serrate or serrate-dentate, biglandular at the base or not, herbaceous. *Flowers* in the Malaysian species solitary in the leaf-axils or in terminal racemes, actinomorphic, ♂, homostylous or heterodistylous, ephemorous. Calyx gamophyllous, 5-fid, after anthesis circumscrib at the base; segments imbricate in bud. *Petals* 5, inserted in the throat of the calyx-tube, contorted in bud, free, shortly clawed or subsessile, deciduous after anthesis. Stamens 5, inserted on calyx-tube, alternating with the petals; filaments filiform-subulate, free; anthers introrse, 2-celled; cells opening longitudinally. Ovary superior, sessile, 1-celled; placentas 3, parietal; ovules 3 to numerous. Styles 3, terminal, free, slender; stigmas penicilliform. *Capsule* globose or ovoid, loculicidally 3-valved. Seeds numerous, incompletely arillate, with a raised scalariform reticulation; endosperm copious, horny or fleshy; embryo large, straight.

Distr. Tropical America and Africa, represented there by 7 genera and about 80 to 100 species; 2 genera (3 species) naturalized in *Malaysia*.

Uses. Sometimes cultivated as ornamentals.

### KEY TO THE GENERA

1. Flowers (in *Malaysia*) in terminal racemes. Calyx ebracteolate. Petals shorter than  $1\frac{1}{2}$  cm. Throat of the calyx with a fimbriate corona, which passes also over the base of the petals. Leaves without basal glands, densely stellate-hairy beneath. . . . . 1. *Piriqueta*
1. Flowers solitary in leaf-axils; pedicel adnate to the petiole. Calyx bibracteolate. Petals longer than  $1\frac{1}{2}$  cm. Throat of the calyx without a corona. Leaves biglandular at base, not stellately hairy beneath. . . . . 2. *Turnera*

### 1. PIRIQUETA

AUBL. Hist. Pl. Guian. Franç. 1 (1775) 298.

Erect annuals, (perennials, shrubs, or trees); indumentum variable. *Leaves* without basal marginal glands, gland-dotted beneath. *Flowers* in erect, terminal racemes; pedicels jointed near the apex. Sepals (free or) connate in the lower  $\frac{1}{3}$ – $\frac{1}{2}$ ; tube above the insertion-point of each stamen with a semicircular thickening, next the insertion-points of the petals with a fimbriate corona, which passes also over the base of the petals. Petals obovate from a cuneate base, glabrous. Stamens inserted a little above the base of the calyx-tube; filaments glabrous; anthers with an emarginate or bifid base and an emarginate apex. Stigmas multifid. *Capsule* globose-ellipsoid. Seeds curved, reticulate-ribbed, with a unilateral aril.

Distr. About  $\pm 19$  spp., most of them in the warmer regions of America, a few in S. Africa and Madagascar; a single American species naturalized in *Malaysia*.

**1. *Piriqueta racemosa* (JACQ.) SWEET in STEUD.** Nomencl. 2, ed. 2 (1841) 344, 724; URB. Monogr. Turner. (1883) 77; Fl. Bras. 13, 3 (1883) 107; BACK. Ann. J.B.B. Suppl. 3 (1909) 410; KOORD. Exk. Fl. 2 (1912) 655; BACK. Bekn. Fl. Jav. em. ed. 4 (1942) fam. 43, p. 1.—*Turnera racemosa* JACQ. Hort. Vindob. 3 (1776) 49, t. 94; DC. Prod. 3 (1828) 348.

Erect annual, 30–60 cm high; stem terete, moderately densely clothed with short, fine patent pubescence, moreover with scattered long, very acute, in sicco brownish, tubercle-based bristles. *Leaves* elliptic-oblong from a rounded or subcordate base, obtuse or acute, dentate-serrate, densely stellately pubescent and thinly bristly on both surfaces, 4–10

cm by  $1\frac{1}{2}$ –5 cm; petiole  $\frac{3}{4}$ –4 cm. Stipules absent. Racemes 10–40 cm, rather lax, leafy only in the basal part. *Flowers* (in Java) homostylous. Pedicels finely stellately pubescent and patently pilose, during anthesis 1–2 cm long, afterwards 2–4 cm, jointed 3–4 mm below the apex. Calyx thinly stellately hairy, 5-fid over  $\frac{1}{2}$ – $\frac{2}{3}$  of its length; segments unequal, ovate, caudately acuminate, acute, with pellucid margins. Petals obovate, with a rounded-truncate,  $\pm$  crenate top, pale yellow,  $3\frac{1}{2}$ –5 mm by  $2\frac{1}{2}$ –3 mm. Filaments  $\pm 2\frac{1}{2}$  mm; anthers  $\pm \frac{3}{4}$  mm; their base sagittate. Ovary broadly ovoid, densely appressed pilose; styles  $\pm 1$  mm; stigmas as long or slightly shorter, yellow. *Capsule* smooth,

with an apical hairtuft. Seeds curved, reticulate-ribbed and distinctly tubercled, brown, glabrous,  $1\frac{1}{2}$ –2 mm long.

Distr. Native of Brazil, long ago introduced into the Bogor Botanical Gardens, since long naturalized in the region between Djakarta and Bogor.

Ecol. Waste places, road-sides, dry fields, 1–

250 m, locally not rarely numerous but on the whole rather scarce.

Note. The Javan plant markedly differs from the description by URBAN, *l.c.*, by the much smaller, homostylous flowers and the possession of many long bristles. Yet I cannot reduce it to another species.

## 2. TURNERA

LINNÉ, Sp. Pl. (1753) 271; Gen. Pl. ed. 2 (1754) no 338.

Erect or ascending perennial (or annual) herbs, (shrubs or trees), invested with simple (or stellate) hairs. Leaves often with 2 marginal basal glands, above the base dentate-serrate, distinctly gland-dotted beneath. *Flowers* solitary in the leaf-axils, heterodistylous or homostylous; pedicel adnate to the petiole, with 2 apical bracteoles. Calyx-tube often with thickenings above the insertion-point of the stamens, segments often very acute. Petals on a short hairy claw, obovate, caducous after anthesis. Stamens inserted above base of calyx-tube, margins of the filaments cohering with base of calyx-tube. Ovary globose-ovoid; stigmas multifid. *Capsule* broadly ovoid, obtuse, verruculose, 3-valved down to near the base; valves with recurved tops. Seeds globular to oblong, often curved, with a raised scalariform reticulation and a unilateral aril.

Distr. Upwards of 50 spp. in the warmer regions of the New World from Mexico to Argentina; 2 of these naturalized in other warm countries, both in *Malaysia*.

Ecol. Both species possess, in their fat-containing aril, an elaiosome, attracting ants; consequently their seeds are dispersed by ants, and both spp. are myrmecochorous (*cf.* LOCK, Ann. R. Bot. Gard. Perad. 2, 1904, 107). In *T. subulata* J.Sm. cross-fertilisation is a necessary condition for setting fruit (*cf.* VAN WELSEME, Trop. Natuur 1, 1912, 148; VAN DER PIJL, *ibid.* 19, 1930, 147; DOCTERS VAN LEEUWEN, *ibid.* 24, 1935, 1). Many insects have been found visiting the flowers.

Note. URBAN, in his monograph, *cf. infra*, accepted the two species distinguished here as belonging to one polymorphic specific population. The observed intersterility, the many morphological and physiological differences induce us to accept them as two good species, though we admit that it is possible that in the centre of the native habitat a swarm of intermediate forms may show them to represent extreme forms of one large collective species.

### KEY TO THE SPECIES

1. Pedicel throughout its length adnate to the petiole. Bracteoles linear-subulate, 1-nerved, entire, without marginal glands,  $\frac{3}{4}$ – $1\frac{1}{4}$  cm by  $1$ – $1\frac{1}{4}$  mm. Calyx  $1\frac{3}{4}$ –2 cm high. Flowers heterodistylous. Petals at the base dark purple, higher sulphureous, at the broadly rounded apex light yellow, overlapping at the base. Corolla at last widely expanded with a campanulate centre. Ovary without apical tubercles. Fruit 5–7 mm high. Seeds fewer than 20. Often bushy from near the base . . . ***T. subulata***
1. Pedicel at the apex free over a length of 3–5 mm; the free part obconic. Bracteoles lanceolate, penninerved, serrate, with 2 large marginal glands,  $1$ – $3\frac{1}{2}$  cm by  $2\frac{1}{2}$ –6 mm. Flowers homostylous. Calyx  $2$ – $2\frac{1}{2}$  cm high. Petals canary-yellow, selfcoloured, with a truncate,  $\pm$  dentate apex, not overlapping at the base,  $2\frac{1}{4}$ – $2\frac{1}{2}$  cm by 11–13 mm, at last almost expanded flat. Ovary with 6 apical tubercles. Fruit 9–10 mm high. Seeds more than 30. Leaves lanceolate or ovate-lanceolate, acute, 4–15 by  $1$ – $3\frac{1}{2}$  cm, rather soon deciduous, leaving on the bare stems a knotty scar; petiole  $\frac{3}{4}$ –2 cm. Erect, branched in the apical part, not bushy . . . ***T. ulmifolia***

1. *Turnera subulata* J. E. SMITH in REES, Cycl. 36 (1819) no 2; DC. Prod. 3 (1828) 346; STEEN. Trop. Nat. 20 (1931) 227, f. 2b; DOCT. v. LEEUWEN, Trop. Natuur 24 (1935) 1–8, f. 1–5; BACK. Bekn. Fl. Jav. em. ed. 4 (1942) fam. 43, p. 2; STEEN. Fl. Sch. Indon. (1949) 289.—*T. trioniflora* SIMS, Bot. Mag. (1820) 2106; RIDLEY, Fl. Mal. Pen. 1 (1922) 838; BURK. Ec. Prod. 2 (1935) 2193.—*T. elegans* OTTO in NEES, Hort. phys. Berol. (1820) 36.—*T. ulmifolia* LINNÉ var. *elegans* (OTTO) URB. Monogr. Turn. (1883) 139; in MART. Fl. Bras. 13, 3 (1883) 159; O.K. Rev. Gen. 1 (1891) 252; BOERL. Handl. 1, 2

(1890) 567; LOCK, Ann. R. Bot. Gard. Perad. 2 (1904) 107–119; BALL, The New Phyt. 32 (1933) 13–36.—*T. ulmifolia* AUCT. DIV. (*non* L.) BACK. in Ann. J.B.B. Suppl. 3 (1909) 419; VAN WELSEME, Trop. Natuur 1 (1912) 147, *cum tab.*; VAN DER PIJL, Trop. Natuur 19 (1930) 193, f. 10.—*T. virgata* WILLD. msc. in SCHULT. Syst. Veget. 6 (1820) 678; DC. Prod. 3 (1828) 348.

Perennial herb, often woody at the base, 30–80 cm high, with a frequently very strong taproot; stems terete, leafy over a considerable length, densely appressed pubescent. *Leaves* not crowded, ovate-

elliptic or ovate-oblong from a cuneate entire base, acute or rather obtuse, very distinctly dentate-serrate, rather densely gland-dotted beneath, on both surfaces, especially the lower, appressed white-pubescent (hairs on the nerves longer and more closely set),  $1\frac{3}{4}$ –9 cm by  $\frac{3}{4}$ –4 cm; midrib and

very conspicuous when bearing open flowers which are very showy and most fugacious.

Uses. Ornamental. In the Malay Peninsula poultices made from the roots are applied to boils.

Vern. *Kembang pukul dēlapan*, M (8 o'clock flower).

Notes. The flowers expand at  $\pm$  8 a.m. and wither  $\pm$  3 hours afterwards or, when the forenoon is very rainy, in the beginning of the afternoon. Cut branches, even when put at once in water, wilt very rapidly.

2. *Turnera ulmifolia* LINNÉ (*s.str.*), Sp. Pl. (1753) 271; J. E. SMITH in REES, Cycl. 36 (1819) no 1; DC. Prod. 3 (1828) 346; TRIMEN, Fl. Ceyl. 2 (1894) 239; BACKER, Ann. J.B.B. Suppl. (1910) 410; KOORD. Exk. Fl. 2 (1912) 655; MERR. En. Born. (1921) 416; RIDL. Fl. Mal. Pen. 1 (1922) 838; STEEN. Trop. Natuur. 20 (1931) 227, f. 1, 2a; BURK. Ec. Prod. 2 (1935) 2194; BACK. Bekn. Fl. Jav. em. ed. 4 (1942) fam. 43, p. 2; STEEN. Fl. Sch. Ind. (1949) 289; HENDERSON, Mal. Wild Fl. 1 (1949) 169, fig. 163.—*T. angustifolia* MILL. Dict. ed. 8 (1768) no 2; Bot. Mag. t. 281, 4137.—*T. ulmifolia* L. var. *angustifolia* WILLD. ex URB. Mon. Turn. (1883) 141; Fl. Bras. 13, 3 (1883) 161; BOERL. Handl. 1, 2 (1890) 567.

Perennial herb, often woody at the base, 40–150 cm high, with a frequently strong taproot; stem terete, usually leafy only in the upper part, densely appressed pubescent. *Leaves* at the tops of the branches often approximate or even crowded, from a cuneate, entire base rather coarsely dentate-serrate, moderately densely and not very distinctly glandular beneath, on both surfaces moderately densely clothed with longish,  $\pm$  patent or appressed



Fig. 1. *Turnera subulata* J.Sm. near Bogor, W. Java, Oct. 1929.

usually also the erecto-patent lateral nerves distinctly prominent beneath. Petiole with 2 rather large apical lateral glands, appressed hairy,  $\frac{1}{2}$ – $1\frac{1}{4}$  cm long. Stipules erect, very minute, long-hairy. *Flowers* in the higher leaf-axils. Pedicel  $\frac{1}{3}$ – $\frac{1}{2}$  cm. Bracteoles at the calyx-base, broadest at the base, very acute. Calyx densely appressed pubescent and gland-dotted without, glabrous within except on the pilose base; tube rather abruptly widened in the upper half  $\frac{1}{2}$ – $\frac{3}{4}$  cm long; segments narrow, very acute, 1– $1\frac{1}{2}$  cm long. Petals with a slightly hairy, 3–4 mm long claw, blade obovate, broadly rounded, entire, above the claw glabrous, finally above the base much spreading or subreflexed, 2– $\frac{3}{2}$  cm by  $\frac{1}{4}$ – $\frac{2}{5}$  cm. Filaments with broad membranous-margined bases; anthers inserted dorsally a little above their base. Ovary ovoid, densely clothed with appressed white hairs, with 3 glabrous apical depressions (style-scars). *Capsule* ovoid, obtuse, finely verruculose, hairy, rather thick-walled. Seeds subprismatical, on one end crowned by a semiglobular boss, brownish yellow,  $2\frac{3}{4}$ –3 by  $\pm$   $\frac{4}{5}$ –1 mm; aril white.

Distr. Native of tropical America, introduced into Java more than a century ago, probably as an ornamental, since long naturalized in Java in the region between Djakarta and Bogor and in Central Sumatra (Padang).

Ecol. Inhabitant of sunny localities, fields, waste places, railway-embankments, railway-yards, old brick walls, 10–250 m, locally often copious,



Fig. 2. *Turnera ulmifolia* L.

white hairs; midrib strongly prominent beneath; petiole with 2 rather large, apical, lateral glands. Stipules erect, triangular,  $\pm 1\frac{1}{2}$  mm, long-hairy. *Flowers* in the higher leaf-axils. Bracteoles lanceolate, broadest far above the middle, very acute. Calyx densely appressed-pubescent without, not distinctly gland-dotted, glabrous within; tube cylindrical, widened only at the very top,  $\frac{1}{2}$ – $\frac{3}{4}$  cm long; segments lanceolate, caudately acuminate, up to 2 cm long. Petals with a short, slightly hairy claw; lowermost part of flower not campanulate, blade obovate,  $2\frac{1}{4}$ –3 cm by 11–15 mm. Ovary ovoid with 6 small apical tubercles and between them 3 minute style-scars, densely white-hairy with a glabrous green top; styles (stigmas included)  $\pm 2\frac{1}{2}$  cm. Capsule ovoid, obtuse, rather thick-walled, 3-valved to below the middle; valves recurved in the upper part. Seeds cylindric-clavate, at the narrow end crowned by a semiglobose boss, brown,  $2\frac{1}{4}$ – $2\frac{1}{2}$  cm by  $\frac{5}{6}$ – $1\frac{1}{4}$  mm; aril white.

*Distr.* Native of the West Indies, already very long ago, as an ornamental, introduced into other warm countries, also into *Malaysia*, and there naturalized in many regions: Sumatra, Malay Peninsula, Riouw, Java, Madura, Borneo.

*Ecol.* In Java in sunny dry localities, 1–20 m, especially in the coastal regions: grassy fields, waste places, under coconuts, often on sandy soil, light jungles, as a rule in scattered specimens. The statement by VAN WELSEME (*Trop. Natuur* 1, 1912, 147) that he found the plant in great numbers in W. Java between Padalarang and Tjimahi (700–750 m alt.) was erroneous. VAN WELSEME saw the plant from a rapidly moving railway-carriage (oral statement of VAN WELSEME); it afterwards proved to be *Argemone mexicana*.

*Uses.* In Java sometimes, but rarely, cultivated as an ornamental.

*Note.* The flowers expand at about 6 in the morning and wither at 11 a.m. Cut branches, when at once put into water, do not wilt rapidly.

## BIXACEAE<sup>1</sup> (C. A. Backer, Heemstede)

### 1. BIXA

LINNÉ, Sp. Pl. (1753) 512; Gen. Pl. ed. 5 (1754) no 581.

Small trees or erect shrubs. *Leaves* spirally arranged, simple, petioled, entire, palmatinerved, densely red-dotted. *Stipules* small, very caducous. *Flowers* in terminal corymbs or panicles, actinomorphic, ♀, rather large. Pedicel with 5–6 apical glands. Sepals 4–5, free, imbricate in bud, falling off as soon as the flower expands. Petals 4–7, free, imbricate in bud. Stamens numerous, inserted on an annular hypogynous disk; filaments thin, free; anthers horseshoe-shaped, passing over the top of the filament and with both ends closely applied to it, 2-celled; cells opening in the middle (on the top of the filament) by short slits which unite into a spuriously apical pore. *Ovary* superior, usually bristly, 1-celled, with 2 opposite parietal slightly intruding placentas. *Style* 1, sinuous, rather thick; stigma 2-dentate. *Ovules* very numerous. *Capsule* compressed contrary to the placentas, usually softly prickly, rarely smooth, loculicidally bivalved; endocarp membranous, separating from the valves. *Seeds* numerous, obovoid, angular; testa fleshy, very densely studded with small, round, red, sessile glands; albumen well-developed, not oil-containing; embryo rather large.

Distr. Monotypic, native and cultivated in tropical America; cultivated in many other tropical countries.

Ecol., Uses. See beneath under *Bixa orellana*.

1. *Bixa orellana* LINNÉ, Sp. Pl. (1753) 512; BURM. f. Fl. Ind. (1768) 120; DC. Prod. 1 (1824) 259; BLUME, Bijdr. (1825) 56, 100; BLANCO, Fl. Fil. (1837) 456; ed. 2 (1845) 317; ed. 3 (1878) 221, t. 231; MOR. Syst. Verz. (1945/46) 34; CLOS, Ann. Sc. Nat. (1857) 260; MIQ. Fl. Ind. Bat. 1, 2 (1859) 108; HOOK. f. Fl. Br. Ind. 1 (1872) 190; KING, Mat. Fl. Mal. Pen. 1 (1890) 54; GRESH. Nutt. Pl. (1894–1900) 49, t. XIV; KOORD. Minah. (1898) 344; K. & V. Bijdr. 5 (1900) 32; K. SCH. & LAUT. Fl. Deut. Sch. Geb. (1901) 451; BECC. Nelle For. (1902) 594; BACK. Fl. Bat. 1 (1907) 62; Schoolfl. (1911) 69; KOORD. Exk. Fl. 2 (1912) 624; MERR. Fl. Man. (1912) 333; Interpr. (1917) 376; Sp. Blanc. (1918) 274; En. Born. (1921) 410; En. Philip. 3 (1923) 103; RIDL. Fl. Mal. Pen. 1 (1922) 252; BACK. & SLOOT. Theonkr. (1924) 176, t. 176; HEYNE, Nutt. Pl. (1927) 1132; BURK. Dict. 1 (1935) 330; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 82, 1; STEEN. Fl. Sch. Indon. (1949) 282.—*Pigmentaria* RUMPH. Herb. Amb. 2 (1741) 79, t. 19.—*Rocu* SONNERAT, Voy. Nouv. Guin. (1776) 29, t. 13.—Fig. 1–2.

Shrub or small tree, 2–8 m high; bark dark-brown, tough; young branchlets densely rusty-scaly, glabrescent. *Stipules* oblong, acute, 6–10 mm long. *Leaves* herbaceous, ovate from a shallowly cordate, less often truncate base, gradually long-acuminate, at first densely scaly beneath, glabrescent, very densely red-dotted,  $7\frac{1}{2}$ –24 by 4–16 cm; 5-nerved; lateral nerves on each side of midrib several, connected by numerous transverse nerves; jarger nerves prominent beneath; petiole terete,

thickened at base and apex, at first densely scaly, glabrescent,  $4\frac{1}{2}$ –12 cm long. *Panicles* or corymbs 8–50-flowered; bracts early caducous, 5–10 mm long. Pedicel terete or subcompressed, thick, densely red-squamosa, 8–10 mm long, much thickened at the apex and bearing there 5–6 large, sessile, shining glands alternating with the sepals. *Flowers* 4–6 cm across. *Sepals* obovate, concave, obtuse, purple, densely rusty-scaly, 10–12 mm long. *Petals* 5–7, unequal, obovate, obtuse or retuse, light red, veined, 2–3 by 1–2 cm, on the back with many oblong dots, deciduous. *Disk*  $\pm$  1 mm high. *Filaments* at the base yellow with a few dots, at the apex red; anthers violet; ovary subglobose, densely clothed with red-blotched bristles,  $2\frac{1}{2}$ –3 $\frac{1}{2}$  mm high. *Style* thickened upwards, 12–15 mm long; stigmatic teeth very short. *Ovules* red-dotted. *Capsule* from a subtruncate base either broadly ovate, with a broadly rounded abruptly and shortly acuminate apex (so in most Indonesian specimens) or elongate-ovate with a much narrowed, rather long-acuminate apex, 2–4 cm long, 2–3 $\frac{1}{2}$  cm wide, more or less densely clothed with long, filiform thickish, very acute, stiffish but not sharp, in a dry state very brittle bristles, at first red, afterwards greenish, finally brown, opening down to the base by two persistent valves; funicles rather long with a disciform apex. *Seeds* 4–5 mm long.

Distr. Frequently cultivated throughout *Malaysia* but no specimens as yet seen from the Lesser Sunda Islands. I never saw an indisputably wild specimen.

(1) In this Flora *Bixaceae* are treated as a monogeneric family.



Ecol. In Java specially in the W. and Central parts, up to ca 2000 m, in living fences and along road-sides, sometimes on premises, rarely in small plantations.

Uses. Formerly frequently used as a wind-break in tea plantations but as such fallen into disuse because of its liability to be attacked by *Helopeltis*.

The form mostly cultivated in Indonesia is the inferior one with broad-topped shortly acuminate fruit (see above); the much superior variety with elongate-ovoid, long-acuminate fruits has been collected only here and there in Java. Both forms

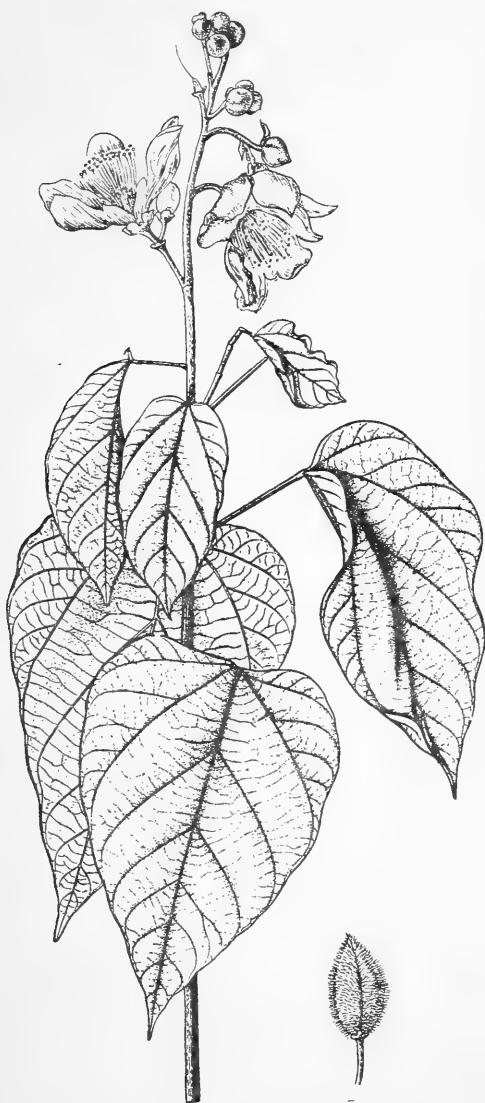


Fig. 1. *Bixa orellana* L. Flowering branch and separate fruit.

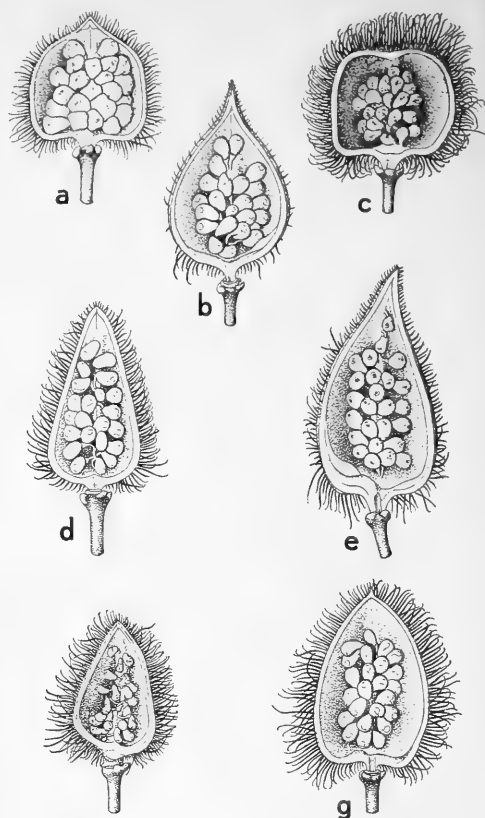


Fig. 2. Some halved fruit of forms of *Bixa orellana* L. at Bogor. *a-c.* white fruits, *d-g.* red fruits.—*a.* hairs brown, fruit yellow-green (V. ii. 8), *b.* hairs and fruit green (V. ii. 6), *c.* ditto (in hedge of Bot. Gard.), *d.* hairs red, fruit greenish (V. iii), *e.* hairs red, fruit green with red apex (V. ii. 2), *f.* fruit and hairs red (iv. F. 88a), *g.* fruit green, hairs red (M. iv. 1). Compiled by EYMA; between brackets number in Bot. Gard. Bogor; all  $\times \frac{1}{2}$ .

are at present economically unimportant. In the Botanic Gardens and Economic Gardens at Bogor many forms are cultivated with different fruit-shapes, in which the late Dr EYMA could distinguish the forms depicted in fig. 2.

A dye (*anatto*) is prepared from the outer coat of the seeds. This dye was formerly used for the colouring of fabrics but this use has gone out as the colour is not durable; anatto has since long been superseded by aniline dyes. At present it is still used for the colouring of butter and cheese. The leaves are sometimes used medicinally for treating fever in children.

Wood anat. VESTAL, Philip. J. Sc. 64 (1937) 222. RECORD & HESS, Timb. New World (1947) 89. METCALFE & CHALK, Anat. Dic. 1 (1950) 106 (fig.).

Vern. *Kasumba* (with many variants and addi-

tions), M, sometimes with the addition *kěling*, which points to introduction from the south of Hindustan (Coromandel, Malabar), or, in a broader sense, from overseas, *galinggém*, *galuga*, S, *barada* (Bugin), *satumbal* (Sumatra), *parada* (Celebes), *djabe bang* (Borneo) and some local names. Philippines: *Achuète* (general), *achiti*, *a(t)suite* (Ilk.), *achóte*, *asúti*, *atseuète* (Tag.), *achoète* (Tagb.),

*apatut* (Gad.), *chanang*, *janang* (Sul.), *chótes*, *sotis* (Bis.).

Note. The late Dr P. J. EYMA made a survey of forms represented at Bogor, noting the shape of the fruit, its colour, the colour and length of the bristles on it, and the colour of the corolla. He found no less than 18 combinations, some of which have been pictured in fig. 2.



Fig. 1. *Typha angustifolia* L. from Java,  $\times 1/2$ .

## TYPHACEAE<sup>1</sup> (C. A. Backer, Heemstede)

### 1. TYPHA

LINNÉ, Sp. Pl. (1753) 971; Gen. Pl. ed. 5 (1754) no 924.

Perennial, palustrial or aquatic herbs with a creeping rhizome; stems erect, solid, submerged at the base. *Leaves* biseriate, partly radical or subradical, partly cauline, lower congested, higher remote, elongate-linear, rather thick and spongy, blunt-margined; their sheathing bases excreting slime on their inner side. *Flowers* very numerous, very closely packed in 2 or less often 3, superposed, contiguous or more or less remote terete unisexual spikes; upper spike male; the 1–2 lower ♀; all spikes at the base with a foliaceous bract which falls off long before anthesis; the ♀ spikes here and there between the flowers often with a similar bract. ♂ *Flowers* consisting of 3 flat hairs together surrounding 2–5 stamens; anthers basifixed, linear, 2-celled; connective shortly produced; cells back to back, bursting longitudinally; pollen-grains free or cohering in tetrads. *Rachis* of ♀ *spathe* closely studded with patent cylindrical thickish excrescences; between these excrescences and on their basal part beset with flowers containing a fertile ovary; higher part of the excrescences bearing rudimentary ovaries. ♀ *Flowers* with or without a very narrow bracteole; bracteole with a more or less broadened, often dentate-acuminate apex either entirely hidden by the flowers or their apex visible externally. Ovary borne by a long very thin stalk (gynophore) which bears long hairs on its base, fusiform, 1-celled; style distinct thin; stigma broadened, unilateral, linear or spatulate. *Fruit* small, fusiform, or elongate-ovoid, falling off together with its stalk from the pilose axis of the spike, finally bursting by a longitudinal slit; seed pendulous, striate; endosperm mealy; embryo narrow, straight, nearly as long as the seed.

*Distr.* Throughout the world between the arctic circle and lat. 35 S, comprising  $\pm 7$  spp., in *Malaysia* only one very variable species.

*Ecol.* Marshy places, shallow pools of fresh or brackish water, often gregarious.

*Uses.* The rhizomes which are rich in starch are eaten in many regions where food is scarce, or in periods of famine. The leaves are used for thatching huts, for matting and for coarse basket-work. The spikes are often used for decoration; the plush of the ripe ♀ spadices was formerly used for stuffing pillows.

*Note.* By GÈZE, GRAEBNER, HALLIER, and others following, various names have been given to Malaysian *Typha*, mostly based on the shape of the bracteoles in the ♀ spike. In my opinion no specific delimitation can be based in Malaysian specimens on these characters, as they vary and merge. And I have accepted all of them as belonging to one species.

**1. *Typha angustifolia*** LINNÉ, Sp. Pl. (1753) 971, *sensu latissimo*; R.Br. Prod. (1810) 338; DECNE, Nouv. Ann. Mus. 3 (1834) 366; SPAN. Linnaea 15 (1841) 479; HASSK. Flora (Bot. Zeit.) 25 (1842) Beibl. 2, p. 112; DE VRIESE, Pl. Jungh. 1 (1854) 106; MIQ. Fl. Ind. Bat. 3 (1855) 173; GRAEBN. Pfl. R. 2 (1900) 11 (*incl. ssp. javanica* GRAEBN.); ASCH. & GR. Syn. Mitt.-Eur. Fl. ed. 2, 1 (1912) 418; KOORD. Exk. Fl. 1 (1912) 69; GÈZE, Ét. Typha (1912) 97; BACK. Handb. Fl. Jav. 1 (1925) 31, *in ann.*—*T. javanica* SCHNIZL. in ZOLL. Syst. Verz. 1 (1854) 77, *nomen*; ROHRB. Verh. Bot. Ver. Brandenb. 11 (1869) 98; HOOK. f. Fl. Br. Ind. 6 (1893) 489; WARB. Bot. Jahrb. 18 (1894) 185; SCHUM. & LAUT. Fl. D. Sch. Geb. (1901) 158; GÈZE, Ét. Typha (1912) 120.—*T. domingensis* PERS. Syn. 2 (1807) 532; GRAEBN. Pfl. R. 2 (1900) 14; GÈZE, Ét. Typha (1912) 115; HALL.

*f. Nova Guin.* 8 (1913) 912, *in ann.*; MERR. En. Philip. 1 (1922) 8; BACK. Handb. Fl. Java 1 (1925) 31; HEYNE, Nutt. Pl. (1927) 126.—*T. domingensis* var. *javanica* GÈZE, Bull. Soc. Bot. Fr. 58 (1911) 459; BACKER, Bekn. Fl. Java em. ed. 10 (1949) fam. 227, p. 1.—*T. capensis* (non ROHRB.) HALL. *f. Nova Guin.* 8 (1913) 911.—**Fig. 1.**

Robust. Stem terete, 1½–3 m high. *Leaves* linear, tapering in their apical part, rather acute, 8–22 cm by 6–16 mm, very convex beneath, by longitudinal and transverse septa divided into a great number of aeriferous compartments; their upper surface canaliculate at the base, higher up flat; their base very markedly sheathing. ♂ *Spike* 15–30 cm long, longer than the ♀ one, separated from it by an interval of ½–12 cm, very rarely contiguous to it, its rachis very distinctly compressed, tapering in the

(1) This family consists of only one genus.

upper part, without excrescences, densely clothed with longish,  $\pm$  woolly hairs, the rachis persistent till long after the fall of the  $\sigma$  flowers but at last falling off. Stamens 2-3 on a minute common stalk, intermixed with narrowly linear or narrowly spatulate hairs; the apex of these often broadened, entire or shortly toothed; anthers linear; connective shortly produced, rounded; pollen-grains free.  $\varphi$  Spike 1 or not very rarely 2 superposed, close together, cylindrical, oblique or rounded at the base, rounded at the top, 7-28 cm long, when ripe 2-2½ cm thick, darkbrown, cushion-like; excrescences on its axis at best 1 mm long. Flowers intermixed with very many bracteoles; these very variable, filiform with a more or less thickened, entire or often toothed-acuminate, brown or brownish apex, either exceeding the slightly brown-tipped hairs of the gynophore and then their apex visible on the outside of the spike or shorter and then hardly or not at all visible externally; hairs on the base of the gynophore rather close-set, white. Style longish; stigma flattened, lanceolate, acute, often curved. *Fruit* with an acute base and broader obtuse or subtruncate apex.

Distr. Throughout the area of the genus, in *Malaysia*: N. Sumatra, Philippines, Java, Karimondjawa Isl., Bawean, Madura, Kangean Arch., Timor, New Guinea.

Ecol. Especially at low altitudes in the plains and there often in slightly brackish water, but also in mountainous districts, often gregarious, up to 1725 m.

Uses. See under the genus.

Vern. *Ampét*, Md, *lěmbang*, M, *ěmbět*, J, *asiwung radja mantri*, *walini*, *wawalingian*, S, *takténas* (Timor), *heikrě* (Nw. G.). Philippines: *Balangót* (Tag., S.L. Bis., P. Bis.), *homai homai* (Bis.), *kaidkéd* (Pang.), *lampakánai* (C. Bis.), *tubal-tubal* (C. Bis.), *buhai-buhai* (P. Bis.), *anibung* (Bon.), *badok-badok* (Ilk.), *dosi-dosi* (Ig.), *palabog* (Buk.), *lisdodde*, D, *lesser reedmace*, E.

Note. On the shape of the bracteoles of the  $\varphi$  flowers some varieties or species have been based. However, these are connected by transitional forms. The most common form in Java has bracteoles of which the much broadened, often dentate tip is visible externally. It has been distinguished as *Typha javanica* SCHNIZL. = *T. domingensis* PERS. var. *javanica* GÈZE.

## FLAGELLARIACEAE (C. A. Backer, Heemstede)

Erect, ascending, climbing or floating perennials, often robust, stoloniferous or not. *Leaves* spirally arranged or bifarious, sessile or distinctly stalked, ovate-lanceolate or oblong-lanceolate-linear, with or without a spirally coiled, tendril-like apex; their sheaths embracing the stem, either closed all round or more or less deeply split on the anterior side. Blade closely longitudinally nerved or subpenninerved; nerves connected by numerous short, often oblique transverse veinlets. *Flowers* arranged in terminal, sessile or peduncled panicles, sessile, actinomorphic, ♂ or unisexual, rather small. Perianth hypogynous, calycine or corolline. Tepals 6, 2-seriately imbricate, free or shortly connate, persistent. Stamens in ♂ and ♀ 6, free; anthers basifixed, 2-celled; cells bursting by an introrse longitudinal slit. Ovary in ♂ and ♀ superior, sessile, 3-celled; cells with a solitary ovule in the inner angle; stigmas 3 or one deeply 3-lobed stigma, sessile. *Fruit* drupaceous, indehiscent. Seeds or kernels 1–3; albumen copious; embryo small.

Distr. Genera 3, in the tropics of the Old World, all of them in *Malaysia*.

Ecol. Inhabitants of damp forests, thickets, morasses and slowly moving parts of rivers.

Uses. Unimportant. Stems used for basket-work; stems and runners sometimes eaten raw; leaves and roots occasionally used for medicinal purposes.

### KEY TO THE GENERA

1. Flowers bisexual. Leaves sessile or very shortly stalked. Terrestrial, not stoloniferous.
2. Erect. Stem fistular. Leaves very distinctly longitudinally plicate, apex not tendril-like, base acute. Perianth calycine . . . . . 1. *Joinvillea*
2. Climbing. Stem solid. Leaves not plicate, tips (except the very lowest) tendril-like, base rounded or subcordate, abruptly contracted into a very short petiole. Perianth corolline, white . . . . . 2. *Flagellaria*
1. Flowers unisexual, ♂ with a small rudimentary ovary crowned by 3 short stigmas; ♀ with 6 anantherous small staminodes and a well-developed ovary with a sessile, depressed, deeply 3-lobed stigma. Stem solid. Lower leaves on rather long petioles, sprouting from a cleft basal sheath. Aquatic or terrestrial, at a somewhat advanced age stoloniferous . . . . . 3. *Hanguana*

### 1. JOINVILLEA

GAUD. Voyage Bonite (1846) t. 39, 40 (*absque diagn.*); BRONGN. & GRIS, Bull. Soc. Bot. Fr. 8 (1861) 264.

Robust, reed-like herbs. Stem enclosed to up or near the panicle by closed leaf-sheaths. *Leaves* spread, lanceolate or linear from a tapering base, herbaceous but hard and stiffish; the transverse veinlets rather distant. Panicle broad, rather lax, pubescent. *Flowers* solitary, distant, small, ♂. Bracts minute, deciduous. Perianth small, calycine. Tepals of about equal length, the outer ovate, acute, inner oblong, obtuse or rounded. Stamens 6 (occasionally 1 aborted?); anthers with a bifid base. Ovary conic; style none or very short; stigmas 3, linear, rather long. *Drupe* broadly ovoid-globose; exocarp thin, succulent; endocarp bony, 2–3-seeded. Seeds globose or ovoid, testa membranous.

Distr. Species 3, closely allied, one in *West Malaysia*, extending from Sumatra across the Malay Peninsula and N. Borneo to Palawan (Philippines), the others far remote in the New Hebrides, N. Caledonia, Fiji, Samoa, and Hawaii.

Ecol. Plants of light forest on a non-swampy soil.

1. *Joinvillea borneensis* BECCARI, Nelle For. Born. (1902) 198; Wand. (1904) 128; MERR. En. Born. (1921) 109; En. Philip. 1 (1925) 190; BURK. & HOLTT. Gard. Bull. 3 (1923) 86; MERR. Contr. Arn. Arb. 8 (1934) 18.—*J. malayana* RIDL. Str. Br. R. As. Soc. 44 (1905) 199; MERR. Philip. J. Sc. 1 (1906)

Suppl. 181; RIDL. Fl. Mal. Pen. 4 (1924) 368, t. 209

Often several-stemmed, 1½–4½ m tall. Stems subterete, hard, glabrous, reedlike. *Leaves* sessile, tapering to a long point, usually along the margins and on both surfaces rough by the presence of numerous rather distant very short, stiff

hairs, sometimes, barring the margins, subglabrous, 35–75 by 5–7½ cm. Leaf-sheaths of a firm texture with well-developed, thinner apical auricles appressed against the stem, faintly and closely longitudinally nerved; nerves at the top converging into the leaf-base. *Panicle* erect, sessile or stalked, 12–35 cm long, 2–3 times branched, rather densely clothed with erecto-patent, short, stiff hairs; branches comparatively thin, widely patent, distinctly sinuous, especially the thinner ones; ultimate branchlets bearing a few distant flowers.

*Flowers* sessile on a thickening of the rachis. Perianth membranous, glabrous,  $\pm$  3 mm long. Filaments filiform. Styles erect or erecto-patent. Drupe broadly ovoid-globose, glabrous, dull red, 2–3-seeded.

Distr. *Malaysia*: N. Sumatra, Malay Peninsula, N. Borneo, Philippines (Palawan, Jolo).

Ecol. Jungles, light forest, forest-borders, often on mountain-ridges, 650–1700 m.

Vern. *Rotan bini* (Mal. Pen.). Philippines: *odyung* (Tagb.).

## 2. FLAGELLARIA

LINNÉ, Sp. Pl. (1753) 333; Gen. Pl. ed. 5 (1754) no 450.

Robust, climbing, entirely glabrous herbs with terete, solid, hard stems. *Leaves* bifarious, subsessile, tapering towards the top and there, barring the very lowest, ending in a dorsally flattened, hard tendril, which is coiled in the shape of a watch-spring and thickens after having grasped a support, firmly herbaceous, densely longitudinally nerved, with numerous rather faint, short, oblique cross-nervules, not plicate. Leaf-sheaths tubular, in the Malaysian species closed up to the very apex. Panicles most variable as to size. *Flowers* ♂. Tepals free, coloured, membranous, 3 inner largest, persistent. Filaments filiform, at last exserted; anthers linear or linear-oblong, inserted with a bifid base. Ovary narrow, obtusely triangular; style very short; stigmas rather long, linear-clavate, at last exserted. Drupe subglobose; exocarp succulent, thin; endocarp bony, 1- or rarely 2-seeded. Seeds globose or, by mutual pressure, more or less flattened; testa crustaceous.

Distr. Species 4, one widely spread from tropical Africa, through tropical Asia, and *Malaysia*, to Polynesia and N. Australia, the 2nd in N. Caledonia, the third confined to the Samoa and Fiji Islands and the Bismarck Arch., and a fourth undescribed species of colossal dimensions in San Cristoval Island (Solomon Isl., L. J. BRASS 2835).

Ecol. Plants of humid but not constantly swampy forests.

Note. To make out whether the tropical African species is a variety of *F. indica*, as sometimes assumed, falls beyond the scope of the present revision.

### KEY TO THE SPECIES

1. Panicle with long, erect, lower main branches and erect secondary branches, fastigiate in habit, peduncled, 30–50 cm long. Flowers inserted at distinct intervals. Drupes 12 mm long, endocarp sulcate, pyrenes 8 mm long . . . . . 2. *F. gigantea*
1. Panicle with short divaricate branches, not fastigiate in habit, hardly peduncled, up to 30 cm long. Flowers very densely packed, without intervals between their insertions. Drupes  $\pm$  6 mm long, endocarp smooth, pyrenes 5 mm long . . . . . 1. *F. indica*

1. *Flagellaria indica* LINNÉ, Sp. Pl. (1753) 333; in STICKMAN, Herb. Amb. (1754) 20; BURM. f. Fl. Ind. (1768) 85; SPAN. Linnæa 15 (1841) 477; BLANCO, Fl. Filip. ed. 2 (1845) 196; ed. 3, 1 (1877) 347; HASSK. Pl. Jav. Rar. (1848) 104; ZOLL. Syst. Verz. (1854) 66; MIQ. Fl. Ind. Bat. 3 (1856) 249; Sum. (1860) 260; F.V.M. Descr. Not. 4 (1876) 73; RIDL. J. Bot. 24 (1886) 358; K. SCH. Fl. Kais. Wilh. Land (1889) 15; HOOK. f. Fl. Br. Ind. 6 (1892) 391, *incl. var. minor* (BL.); KOORD. Minah. (1898) 305; K. SCH. & LAUT. Fl. D. Schutzgeb. Süds. (1901) 215; RENDLE, J. Bot. 39 (1901) 177; BAILEY, Queensl. Fl. 5 (1902) 1658, *incl. var. gracilicaulis* BAIL.; MERR. Govt Lab. Publ. Manila 27 (1905) 87; WINKL. Bot. Jahrb. 44 (1910) 526; KOORD. Exk. Fl. Java 1 (1911) 269; LAUT. Bot. Jahrb. 50 (1913) 289; GIBBS, J. Linn. Soc. 42 (1914) 167; DOMIN, Bibl. Bot. 20 (1915) 504; RIDL. Trans. Linn. Soc.

Bot. II, 9 (1916) 231; MERR. Sp. Blanc. (1918) 93; Int. Herb. Amb. (1917) 133; EN. BORN. (1921) 109; KRAUSE, Bot. Jahrb. 59 (1921) 544; WHITE, Proc. R. Soc. Queensl. 34 (1922) 17, *incl. var. minor*; MERR. En. Philip. 1 (1923) 191; RENDLE, J. Bot. 61 (1923) Suppl. 57; KRAUSE, Nova Guin. 14 (1924) 180; RIDL. Fl. Mal. Pen. 4 (1924) 368; BACKER, Handb. 3 (1924) 3; HEYNE, Nutt. Pl. (1927) 426; WHITE, J. Arn. Arb. 10 (1929) 203, *incl. var. minor*; RIDL. Disp. (1930) 320; BURK. Dict. (1935) 1024; LAM, Blumea 5 (1942) 166; HATUSIMA, Tokyo Bot. Mag. 56 (1942) 421, *incl. var. gracilis*; BACKER, Bekn. Fl. Java em. ed. 10 (1949) fam. 212, p. 1.—*Palmijuncus laevis* RUMPH. Herb. Amb. 5 (1741) 120, t. 59, f. 1.—*Fl. minor* BL. in ROEM. & SCHULT. Syst. 7, 2 (1830) 1493; ZOLL. Syst. Verz. (1854) 66; MIQ. Fl. Ind. Bat. 3 (1856) 249; Sum. (1860) 260, 598, *incl. var. linearifolia* MIQ.; KURZ, Nat. Tijd.

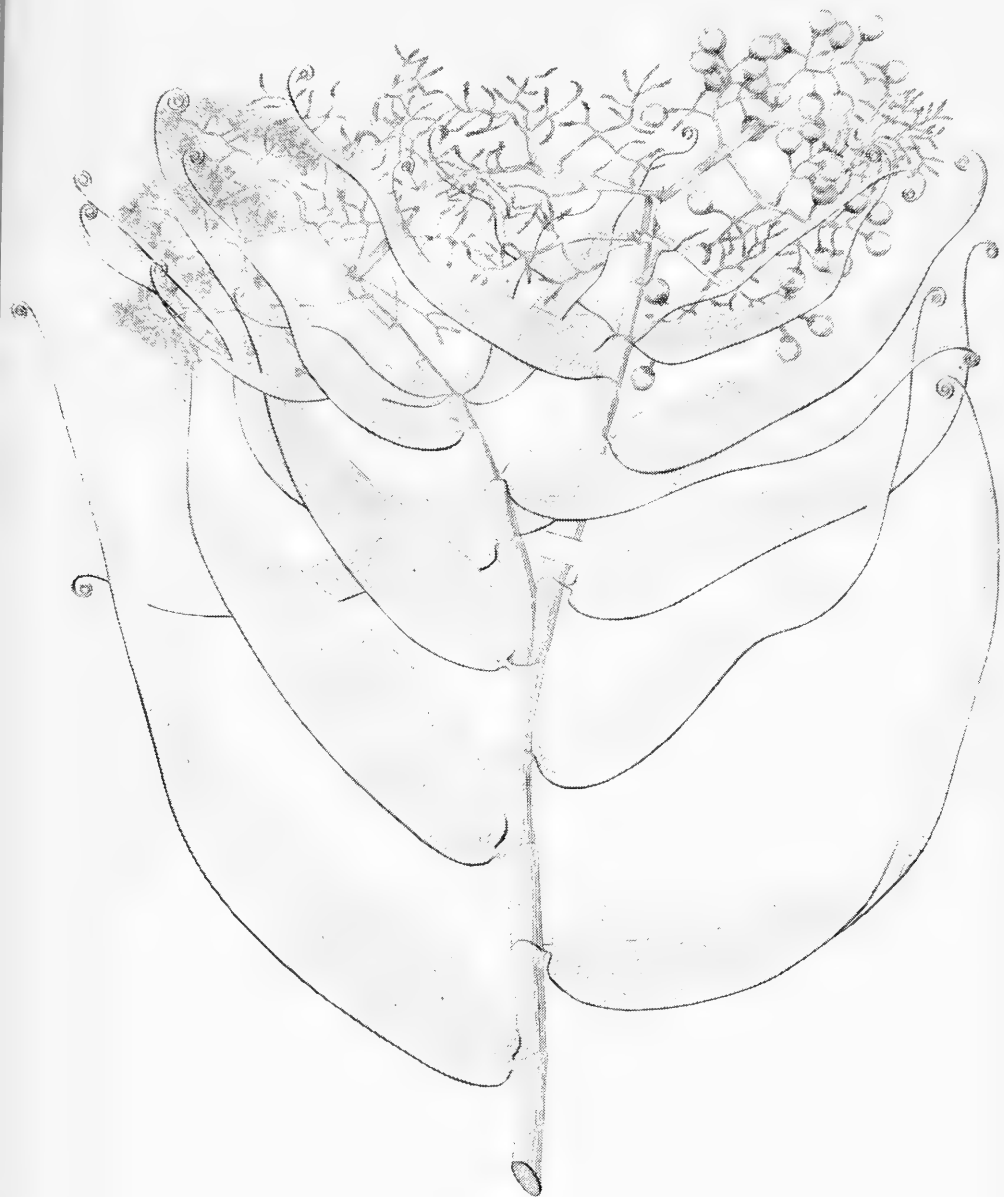


Fig. 1. *Flagellaria indica* L.,  $\times 1/2$  (the right branch of the fork has been drawn in fruit, in its natural position).

N.I. 27 (1864) 221.—*Fl. philippinensis* ELM. Leaf. 1 (1908) 274.—Fig. 1.

Perennial climber, 2–15 m long, rarely longer. Stem in the basal part often more or less woody, higher up herbaceous but hard. *Leaves* bifarious, ovate to lanceolate or linear, base rounded or slightly cordate, abruptly contracted into a dorsally flattened petiole 3–10 mm long, firmly herbaceous, most variable as to size, 3–50 by  $1/2$ – $6\frac{1}{2}$  cm; sheath terete, 1–7 cm long, subtruncate, faintly herbaceous,

ous, on both sides of the petiole with a very narrow thinner apical rimlike auricle, longitudinally ribbed; ribs at the top converging into the petiole. Panicle erect, mostly forked and consisting of 2 main branches, widely branched (often from the very base), 3–30 cm long, bearing on its short ultimate branchlets the sessile flowers in very short, dense spikes. *Flowers* solitary, subtended by a short, broad, bract, white, odorous. Tepals erect, oval, rounded, thinly membranous,  $2\text{--}2\frac{3}{4}$  mm long, stamens and



stigmas at last far exserted. Ovary narrow; stigmas erecto-patent. *Drupe* subglobose, smooth, pink,  $\pm$  6 mm diam., mostly with a single fertile 1-seeded cell and 2 minute empty ones, rarely with 2 fertile and 1 empty cell.

Distr. ?Trop. Africa, Ceylon, tropical SE. Asia, throughout *Malaysia*, Melanesia, and Polynesia to N. Australia.

Ecol. Moist (not swampy) forests from the sea-coast up to 1500 m, frequent in forest-borders along the inner margin of the mangrove. *Fl.* fr. Jan.-Dec.

Uses. Stems sometimes used for basket-work as a rather poor substitute for rotan (rattan). Young stems and leaves used for making hair-wash. Various medicinal applications are recorded.

Vern. Very many local names of which may be mentioned: *lumpui*, S, *owar*, S, Md, *kokrok*, wowo, *wala(n)*, J, *rotan* (with diverse additions such as *apit*, *dini*, *kroh*, *laki*, *lanang*, *manchik*, *marouw*, and several others in Malay-speaking regions), *rotang da ursa* (Sum. E.C.), *oewat'a* (Talaud), *róma* (Morotai), *paikat laki* (Dayak), *mung* (Finschhafen), *monggan* (Konstantinhafen). Philippines: *Anuád*, *iñguál*, *uái-ti-uák* (Ilk.), *aráyan*, *iñgúla* (Tag.), *baling-uái* (Tag., Pamp.), *auái* (Ig.), *auái-si-gáyang*,

*venagaíang* (Is.), *boboáya*, *ouag-ouág* (Mbo.), *hoág-uái*, *ouág-oái* (Bik.), *huág* (S. L. Bis., Mbo.), *(h)uák* (Bis.), *inúal* (Pang.), *kala-uái*, *kala-uaiuai*, *tinúung* (Ibn.), *páua*, *sagákap*, *tauá* (P. Bis.), *uág* (Sul., Bis., Bag., Bik.).

Note. A small-leaved form has been described as *Fl. minor* BL., a large-leaved one as *Fl. philippinensis* ELM. Between these and the normal forms all intergrades occur; they can not even claim varietal rank.

Sterile specimens show a faint resemblance with *Gloriosa superba* L., which has subsimilar leaves, but may be at once recognized by the not-bifarious sheathless leaves.

*Fl. neocaledonica* SCHLTR. is different by its size, dorsally keeled sheaths, a cordate leaf-base, &c.

2. *Flagellaria gigantea* HOOK. f. *IC. Plant.* 15 (1883) t. 1429; LAUT. *Bot. Jahrb.* 45 (1911) 358; KRAUSE, *ibid.* 50 (1913) 289; *ibid.* 59 (1925) 546.

Distr. Fiji, Samoa, and the Bismarck Arch. (New Ireland), might occur also in New Guinea.

Certainly distinct from the preceding species, in which also coarse specimens and broad cordate-based leaves occur. REINECKE 264 from Samoa exactly matches the original description.

### 3. HANGUANA

BLUME, *En. Pl. Java* (1827) 15.—*Susum* BL. in SCHULT. *Syst.* 7 (1830) xcv, 1493.—*Veratronia* MIQ. *Fl. Ind. Bat.* 3 (1859) 553.

Ascending herb, often robust, at a somewhat advanced age stoloniferous. Stem terete, solid. Stolons creeping or floating, often long, enveloped by appressed sheaths which finally dissolve into fibres. *Leaves* for the greater part crowded at the base of the plant, erecto-patent, lanceolate from an acute, often decurrent base, rather thick, densely longitudinally nerved, with numerous close-set thin cross-nervules, between the longitudinal nerves very densely and finely longitudinally striate, not plicate; lower leaves long-petioled; higher leaves much more remote, smaller, on shorter petioles; topmost ones sessile or subsessile with a broad base, small, passing into the primary bracts. Lower leaf-sheaths long and broad, stem-clasping, deeply split on the anterior side, gradually narrowed into the petiole. Panicles peduncled, 1-3 times patently branched; primary branches 1 to several in the axils of rather large bracts, usually branched again; ultimate branches spiciform. *Flowers* more or less distant, either solitary or in small clusters, sessile with a broad base in the axil of a short, broad bract, ( $\sigma$ ) ( $\rho$ ). Tepals shortly connate at the base, green or yellowish or the inner dotted with red; 3 outer short; 3 inner considerably longer, vaulted.— $\sigma$ : Branches of panicle usually thinner and longer than those of  $\rho$ , often with a greater number of flowers. Stamens 6, on the base of the perianth, about as long as the inner tepals; filaments filiform from a broader base; anthers small, inserted in a basal cleft. Ovary rudimentary, small; stigmas 3, erect or erecto-patent, shortly clavate.— $\rho$ : Staminodes 6, inserted on the base of the perianth, anantherous; those opposite the outer sepals very minute, narrowly triangular; 3 others much longer and broader, rounded, dorsally compressed. Ovary broadly ovoid-globose; stigma sessile, deeply divided into 3 spreading broadish short arms. *Fruit* drupaceous; exocarp thick, fleshy; endocarp thin-walled, 3-celled, 1-3-seeded.

Distr. Monotypic, tropical SE. Asia to *Malaysia*, and Micronesia (Palau).

Note. The fruit is not baccate, as is often mentioned in literature. Dr G. ERDTMAN, Stockholm, finds the pollen much resembling that of some *Liliaceae*. KURZ, *l.c.*, also stresses this affinity.



Fig. 2. *Hanguana malayana* (JACK) MERR. Colony in Rawa Tembaga, E of Djakarta.

1. *Hanguana malayana* (JACK) MERR. Philip. J. Sc. 10 (1915) Bot. 3; En. Born. (1921) 109; En. Philip. Pl. 1 (1923) 191; KRAUSE, Nova Guin. 14 (1924) 180; Bot. Jahrb. 59 (1925) 546; BACK. Bekn. Fl. Java, em. ed. 10 (1949) fam. 212, p. 2, *incl. ssp. kassintu* (BL.) & *anthelminthica* (BL.); BAKH. V. D. BRINK Jr, Blumea 6 (1950) 399, *incl. var. anthelminthica*.—*Olax zeylanica* (non L.) GAERTN. Fruct. 2 (1791) 414, *cf.* HALL. f. Rec. Trav. Bot. Néerl. 15 (1918) 61.—*Veratrum malayanum* JACK, Mal. Misc. 1 (1820) 25; in HOOK. Bot. Misc. 2 (1831) 74.—*Hanguana kassintu* BL. En. Pl. Java (1827) 15; ed. 2 (1830) 15.—*Susum anthelminthicum* BL. *ex* ROEM. & SCHULT. Syst. 7, 2 (1830) 1493; ZOLL. Syst. Verz. (1854) 66; MIQ. Fl. Ind. Bat. 3 (1856) 247; Sum. (1860) 259, 598; KURZ, Flora 56 (1873) 224; J. As. Soc. Beng. 45, ii (1875) 199; HOOK. f. Fl. Br. Ind. 6 (1892) 391; KOORD. Exk. Fl. 1 (1911) 270; RIDL. Fl. Mal. Pen. 4 (1924) 369; Disp. Pl. (1930) 186; LANE-POOLE, For. Res. N.G. (1925) 77; BURK. Dict. 2 (1935) 2109.—*Veratonia malayana* MIQ. Fl. Ind. Bat. 3 (1859) 553.—*Susum minus* MIQ. Fl. Ind. Bat. Suppl. (1860) 260, 598.—*Susum malayanum* PLANCH. *ex* HOOK. f. Fl. Br. Ind. 6 (1892) 391; HUB. WINKL. Bot. Jahrb. 44 (1910) 526; LAUT. Bot. Jahrb. 50 (1913) 289; RIDL. Fl. Mal. Pen. 4 (1924) 369; BACK. Handb. 3 (1924) 3, *incl. f. sylvatica* & *aquatica*; HEYNE, Nutt. Pl. (1927) 427; VAN DEN ENDE, Trop. Natuur 26 (1937) 128 *seq.*, f. 2-6; BURK. Dict. 2 (1935) 2109.—*Susum kassintu* KURZ,

Flora 56 (1873) 224.—*Hanguana aquatica* KANEHIRA, Trans. Nat. Hist. Formosa 25 (1935) 8, f. 10; J. Dep. Agric. Kyushu Imp. Univ. 4 (1935) 286.—Fig. 2.

Perennial herb, very variable as to the dimensions of all its parts (except those of the flowers), either aquatic (in morasses and slowly moving water) or terrestrial (in humid forests). Stem ascending, above the lower rooting or floating part rigidly erect,  $1\frac{1}{2}$ –2 m high (panicle included), at a somewhat advanced age emitting from the basal part one or more creeping or floating densely sheathed, often long runners which at their apex develop into a new plant behaving in the same way, especially those of the often very robust aquatic form, which frequently generate large, dense, nearly impenetrable masses, parts of which frequently separate, by a rise of the water, from the motherplant and form floating islands. The terrestrial form, as a rule, much less robust and forming fewer, shorter, feebler runners, not generating dense masses. Both forms, when young, usually more or less densely crispy hairy, afterwards glabrescent. Leaves stiff, 20–120 by  $1\frac{1}{2}$ –15 cm. Panicle (disregarding peduncle) 10–120 cm long, 1–3 times branched. Outer tepals 2–2½ mm long, inner 2½–3 mm. Drupe oblong, much surpassing the perianth, up to 2 cm long, shining red.

Distr. Ceylon, Indochina, Micronesia (Palau), in *Malaysia*: as yet not collected in the Lesser Sunda Islands and the Moluccas.

Ecol. From the plains up to  $\pm 1500$  m, in morasses, along lake-shores and rivers, in slowly moving fresh water and in humid forests. See description of the species above. In the *Hanguana*-morasses this plant frequently suppresses all other species with the exception of a few orchids (e.g. *Vanda hookeriana* RCHB. f. which seems to have a predilection for such localities) and is able to form floating islands in lakes. The floating capacity is due to the air in the numerous air-vessels in the plant; a fresh rhizome 50 cm long, 10 cm diam. weighed hardly  $1\frac{1}{2}$  kg (VAN DEN ENDE, l.c.).

Uses. BLUME in ROEM. & SCHULT. l.c. p. 1494 states that the roots of the aquatic form (*anthelminthica*; see beneath) are used in Java by veterinary surgeons as a vermifuge. This statement has not been confirmed by any subsequent author. In New Guinea the stems and runners of this form are said to be eaten raw by the Papuans.

Vern. *Attu ara*, *sa humbang* (Sum. E.C.), *bahong* (Batak), *bakung ayer* (Banka), *bangkung* (Djambi), *kasintu*, *poar*, *S*, *tjakung*, *J*, *djeluwong rimbo*, *M*, *pui* (Dayak).

Note. The aquatic form has been described as *Susum anthelminthicum* BL. = *S. malayanum* PLANCH. f. *aquatica* BACK. = *Hanguana malayana* MERR. subsp. *anthelminthica* BAKH. f. The terrestrial form was described as *Hanguana kassintu* BL. = *Susum malayanum* PLANCH. f. *sylvatica* BACK. = *Hanguana malayana* MERR. subsp. *kassintu* BAKH. f. Though the typical aquatic and terrestrial forms look very different, the differences are, as a matter of fact, of very slight taxonomic value. The 2 forms differ mainly by their size and are connected by a series of intermediates; they can lay no claim to the rank of species or subspecies, not even to that of varieties, and are simply edaphic forms comparable to those of *Polygonum amphibium* in Europe.

VAN DEN ENDE, l.c., maintains to have found all flowers  $\sigma$  in S. Sumatra, but I surmise he mistook the staminodes for stamens. At Bogor Bot. Gardens, and in the Rawa Lakbok, Central Java, I never found fruit in  $\sigma$  specimens.

The first who identified *Veratronia* with *Susum* was KURZ (1873) followed by BECCARI (Bull. Soc. Tosc.ortic. 8, 1884, 70, cum tab.).

## CALLITRICHACEAE (C. A. Backer, Heemstede)

### 1. CALLITRICHE

LINNÉ, Sp. Pl. (1753) 969; Gen. Pl. ed. 5 (1754) no 13.

Delicate, annual or perennial herbs, aquatic and then either entirely submersed, or floating in the upper part, or, in humid localities, not rarely terrestrial and creeping, with slender stems. *Leaves* opposite, at the summits of floating stems often spuriously rosulate, exstipulate, small, linear, elliptic, oblong or spatulate, entire, herbaceous, in the *Mal. sp.* triplennerved. *Flowers* minute, unisexual, axillary, solitary or rarely one ♂ and one ♀ flower from the same axil, often with 2 caducous, transversal, opposite, tender concave bracts. Calyx and corolla absent. ♂: Stamen 1; filament thin, anther 2-celled, cells bursting lengthwise, the slits becoming confluent at the top. ♀: Ovary sessile or subsessile, 4-lobed, 4-celled. Ovule solitary in each cell, pendulous from the top of the cavity. Styles 2, free, often long, papillose. *Fruit* 4-lobed, with longitudinally margined or winged lobes. Testa membranous; endosperm fleshy; embryo terete, straight.

*Distr.* Only genus in the family, worldwide distributed, not yet known from S. Africa and in various regions scarce, in *Malaysia* apparently very rare, the only record proving its being indigenous is from the New Guinean highlands. Because of their small size terrestrial forms are easily overlooked.

*Ecol.* Stagnant or slowly moving fresh water, or, in humid localities, terrestrial, often gregarious.

*Notes.* The number of recognized species greatly depends on personal conception of specific delimitation, and so varies from few to  $\pm 25$ . The difficulties are partly due to the inconstancy of the vegetative characters under various ecological conditions. Submerged leaves of several species are narrowly linear with a notched apex as figured in HEGI, Ill. Fl. Mitt.-Eur. 5, 1 (1925) f. 1804, as, c. See below under *C. verna*.

*Nomencl.* The nomenclature of the species is, if formal typification is applied, very much confused, according to HYLANDER (Uppsala Univ. Årsskr. 1945, no 7, p. 235–236). As SAMUELSSON has shown (Veröff. Geobot. Inst. Rüb. 3, 1925, 603–628, fig. 1), the earliest Linnean species *C. palustris* embraces 5 species. LINNÉ himself split it into two others, one of which is, of course superfluous, and both of which also comprise more than one species. Following SAMUELSSON, the best, at least the most practical, solution is to reject these earlier Linnean names as *nomina ambigua*, and accept the species as defined or emended by LÖNNROTH in his Uppsala thesis of 1854, as has been done by most subsequent authors.

*Syst.* There is no unanimity about the systematical position of the genus which is placed in the *Geraniales* by ENGLER, and in the *Lythrales* by HUTCHINSON. C. A. JÖRGENSEN (Jahrb. Wiss. Bot. 64, 1925, 440–442) is of opinion that it represents a reduced sympetalous type.

**1. *Callitriche verna* LINNÉ**, Fl. Suec. ed. 2 (1755) 2; KÜTZING in RCHB. Ic. Bot. Cent. 9 (1831) t. 881; Linnaea 7 (1832) 175; *emend.* LÖNNROTH, Thesis Uppsala (1854); KOCH, Syn. Fl. Germ. (1837) 212; HEGELM. Monogr. Callitriche (1864) 55; SAMUELSSON, Veröff. Geobot. Inst. Rüb. 3 (1925) 623–624, f. 1e; HEGI, Ill. Fl. Mitt.-Eur. 5, 1 (1925) 290, f. 1804 d1–d6; PAX & HOFFM. in E. & P. ed. 2, 19c (1931) 239, f. 126 A–E; MERR. & PERRY, J. Arn. Arb. 29 (1948) 158.—*C. papuana* MERR. & PERRY, Journ. Arn. Arb. 22 (1941) 258.—**Fig. 1.**

SAMUELSSON *l.c.*, points attention to the extremely high vegetative polymorphism of this species, due to habitat. There seems to be no necessity to name all these forms.

The Malaysian materials belong to 3 forms, a terrestrial, an aquatic partly emersed, and an aquatic entirely submersed form. The first and the third form differ much in aspect.

#### *Terrestrial form.*—**Fig. 1.**

Minute delicate creeping herb rooting at the base, stem thin, branched, 1–2½ cm long, rather

densely leafy. Roots solitary from the lower nodes, thin, rather long. *Leaves* opposite, not pseudo-rosulate, elliptic-oblong-spatulate from a mostly cuneate or contracted, less often obtuse base, rounded at the apex, 1¼–1½ mm by ¾–1¼ mm; petioles either passing gradually into the blade (spatulate leaves) or distinctly set off (elliptic leaves), at best 1¼ mm long. *Flowers* in very many leaf-axils, sometimes in one axil only of a pair, mostly however in both axils and then either both of them ♀, or one ♀, the other male (pseudo-male?), subsessile; bracts not found. ♂: Filament erect, thin, at best ½ mm long; anther minute, yellow; cells bursting, but apparently effete; connective slightly produced between the cells. ♀: *Fruit* much compressed, broadly obovate or subcuneate, distinctly notched,  $\pm 1$  mm by ¾ mm; fruit-lobes rounded at the apex, very narrowly double-winged on the back; wings broadest at the apex ( $\pm 1/10$  mm), very thin, pairwise approximate and parallel; the pairs opposite. Styles spreading, very short, at best ½ mm, finally deciduous; pericarp translucent. Seeds obliquely ovoid-oblong, rather thick, brown,

finely reticulate-ribbed, fully  $\frac{3}{4}$  mm long,  $\frac{1}{3}$  mm broad.

Distr. *C. verna*, taken in a strict sense, occurs in N. and ?S. America, throughout Europe, ?N. Africa, temperate regions of Asia, ?Queensland, in Malaysia: Java.

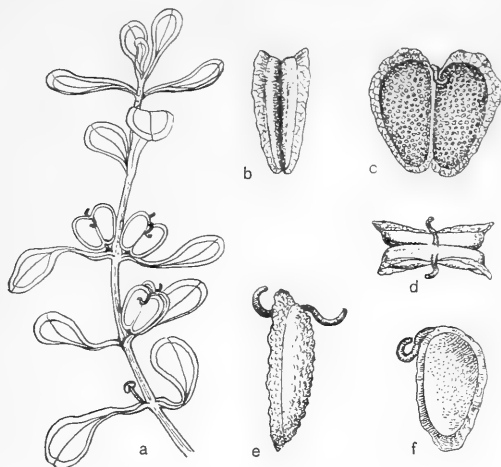


Fig. 1. *Callitriche verna* L. a. Tip of a stem, b-f. ripe fruit (b-c. lateral, d. seen on top, e-f. detached segments). All enlarged (after material from Tjibodas).

The above described terrestrial form in Malaysia was thus far collected only in the Mountain Garden Tjibodas (W. Java, alt.  $\pm 1450$  m); there possibly rather recently introduced but thriving very well and spontaneously reproducing. May be expected to spread outside of the garden.

Ecol. Humid, stony localities, there mixed with other small moisture-loving plants.

Note. Found in Java for the first time in 1950 by Dr S. J. VAN OOSTSTROOM & Mr J. H. KERN; then already numerous but very local, easily escaping observation. The Java form seems to be closely related to *f. caespitosa* SCHULZ (see HEGI,

*l.c.*, 201, f. 1808), which mainly differs by its much larger dimensions. Though the stamens and the styles of the Javan plant seem to be abortive, ripe fruits are abundantly produced.

*Aquatic, partly emerged form.*

Much larger than the above described terrestrial form, 10 cm or more long, very much branched, forming dense masses. Leaves spatulate,  $\pm 10$  by  $\pm 3$  mm (including the long petiole), rounded at the apex, with many sessile, patent, circular shallowly lobed hairs, resembling dots. Stamen of  $\sigma$  4-5 mm; ovary of  $\varphi$  as in the above described terrestrial form, but styles much longer (up to 4-5 mm); fruit as in the terrestrial form.

Distr. In Malaysia: NE. New Guinea (Morobe District), 2700 m (M. S. CLEMENS 5733, 41125).

*Entirely submersed aquatic form (C. papuana MERR. & PERRY, l.c.).*

Leaves very narrowly linear with a subcircular apical incision, 1-nerved, up to 15 mm by  $\frac{1}{3}$ - $\frac{1}{2}$  mm.  $\sigma$  Flowers unknown.  $\varphi$  Flowers very shortly pedicelled. Styles divergent,  $1\frac{1}{2}$ -2 mm long. Almost ripe fruit  $\pm 1\frac{1}{2}$  mm long, ellipsoid-obovoid, slightly longer than broad, slightly notched at the apex, compressed but rather thick; wings along the narrower sides of the fruit, pairwise approximate, parallel, very narrow; seeds oblong.

Distr. In Malaysia: Central New Guinea (BRASS 9541).

Ecol. Rooting in shallows of Lake Habbema, 3225 m.

Note. Notwithstanding the different aspect of the plant the fruits of this submerged form agree fully with those of *C. verna* barring the slightly larger dimensions of the former.

*Excluded*

*Callitriche sp.* mentioned by KURZ (Nat. Tijds. N.I. 27, 1864, 167) from clear streams in the Menumbing Hills, Banka Island, seems very doubtful, firstly because KURZ's material was sterile and has not been traced in the herbarium, and secondly because all specimens of *Callitriche* hitherto found in the Malaysian tropics occur at much higher altitudes.

## VALERIANACEAE (C. A. Backer, Heemstede)

### 1. VALERIANA

LINNÉ, Sp.Pl. (1753) 31; Gen. Pl. ed. 5 (1754) no 43.

Perennial herbs, with a short, often strong-smelling rootstock. Lowest leaves in a basal rosette, higher ones decussate, simple, odd-pinnate or deeply pinnatifid, exstipulate but those of one pair often connected by a raised line, radical ones often long-petioled. Flowers small, ♂ or unisexual, bracteate, sessile, cymose; cymes united into an often large, terminal panicle or corymb. Bracts small, opposite, persistent, oblong or linear, on the ultimate branchlets of the inflorescence only one bract of each pair flower-bearing. Calyx small, persistent; limb during anthesis short, inrolled, deeply divided into 10 or more segments, these in fruit unrolling, much accrescent, finally widely patent, plumose, pappus-like. Corolla gamopetalous, caducous after anthesis, small; tube funnel-shaped, much widened above the very short, narrow basal part, unequalsided; lobes 5, patent, oblong, imbricate in bud. Stamens 3, inserted about halfway down on the corolla-tube, alternating with the lobes, exserted or not; filaments thin; anthers small, versatile, 2-celled, oval-suborbicular, or sub-biglobose, cells opening lengthwise. Ovary inferior, 3-celled, only one cell perfect, 1-ovuled, the two others barren or imperfect; ovule pendulous. Style thin, filiform, shortly 3-lobed or subentire, glabrous, exserted or not. Fruit small, dry, indehiscent, 1-seeded, ovate-oblong, much compressed, with 3 dorsal, 1 ventral, and 2 marginal ribs, 1-celled, the two barren or imperfect cells either enlarged or reduced to narrow ridges. Seed pendulous; albumen absent or scanty.



Fig. 1. *Valeriana hardwickii* WALL. Young flowering stemtop and separate leaf,  $\times \frac{2}{3}$ .

Distr. Very many spp. centering in Andine Chile, the others nearly all on the N. hemisphere,

scarce in the mountainous districts of the tropics, absent from Australia, in *Malaysia* only known from Central Sumatra and Java.

Ecol. Open or slightly shaded, moderately moist localities in the mountains.

Use. Shortly after the outbreak of the second World War H. A. C. BOELMAN & U. G. BIJLSMA in Java showed the tincture of *Valeriana hardwickii* to be equivalent in pharmaceutical properties to *radix valerianae officinalis* (cf. *Natuurwet. Tijds. N.I.* 101, 1941, 194–199), and to furnish a valuable substitute.

1. *Valeriana hardwickii* WALL. in ROXB. Fl. Ind. ed. CAREY & WALL. 1 (1820) 166; D. DON, Prod. (1825) 159; DC. Prod. 4 (1830) 640; WALL. Pl. As. Rar. 3 (1832) 39, t. 263; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1881) 213; O. K. Rev. Gen. 1 (1891) 303; KOORD. Exk. Fl. 3 (1912) 288; RIDL. J. Fed. Mal. St. Mus. 8, 4 (1917) 44; KOORD. Fl. Tijds. 3, 2 (1918) 40; BÜNNEMEIJER, Trop. Natuur 10 (1921) 57, f. 10; STEEN. Bull. J.B.B. III, 13 (1936) 258, 403; BACKER, Bekn. Fl. em. ed. 8 (1949) fam. 176, p. 2.—*Valeriana javanica* BL. Bijdr. (1826) 919; MOR. Syst. Verz. (1846) 70; JUNGH. Java ed. 2, 1 (1853) 596; ZOLL. Syst. Verz. (1854) 119; MIQ. Fl. Ind. Bat. 2 (1856) 118; KOORD. Nat. Tijds. N.I. 60 (1901) 373; HALLIER f. Meded. R.H. 12 (1912) 17.—Fig. 1.

Erect, 0.3–2 m high; stem terete, fistular, finely hairy when young, soon glabrescent; lower internodes short, higher ones longer, upper often very long. Leaves odd-pinnate or very deeply pinnatifid; petiole and leaf-rachis finely hairy when young, glabrescent; petiole 1–3 cm, rachis 3–11 cm; leaflets (segments) 3–9, ovate to oblong or lanceolate from an acute, obtuse or rounded base, long acuminate-caudate, more or less coarsely serrate-dentate; terminal segment largest, stalked, 4–12 by 2–6 cm; lateral ones subsessile, often  $\pm$  oblique, 2–7 by 1–3 cm. Terminal panicle 14–60 cm, with opposite, erecto-patent main-branches; cymes

often long-stalked, widely branched, many-flowered; flowering bracts 3–5 mm long, obtusely acuminate, 1-nerved. Corolla milky white, tube 1 $\frac{1}{4}$ –2 mm; segments patent, oval with an obtuse or rounded apex 1 $\frac{1}{4}$ –2 mm long. Filaments sometimes not or hardly, sometimes distinctly exerted, glabrous, 1–2 mm, rarely shorter. Style exert or not, 1 $\frac{1}{4}$ –2 $\frac{1}{2}$  mm. Fruit brown, glabrous or subpubescent,  $\pm$  2 $\frac{3}{4}$  mm long; calycinal bristles 10–11, on the mature fruit widely spreading, long-plumose, 5–7 mm long.

Distr. Continental SE. Asia, in *Malaysia*: Central Sumatra (rare), Java (throughout).

Ecol. Sunny or slightly shaded localities, meadows, thickets, large forest-glades, *Casuarina* and subalpine mixed forests, sometimes as a weed on fields, locally often numerous and arresting the eye by a profusion of white flowers, 1400–3200 m.

Use. See under the genus.

Vern. *Lompong alas* (Tengger), *gědēbēs* (Gedeh), *kutēt gamong*, *t(ē)ropongan*, J, *padang tundah*, *sēmprētān*, M (because children make trumpets and whistles from the hollow stems), *Javaanse valeriaan*, D.

Note. The smell of the bruised rhizome reminds that of *Valeriana officinalis* L. The plumed fruits are readily dispersed by wind over some distance (like those of many Composites). The flowers seem to be dimorphic.

#### Exclusively cultivated

According to BAKHUIZEN VAN DEN BRINK Jr (in BACKER, Bekn. Fl. Java em. ed. 8, 1949, fam. 176, p. 2) *Kentranthus ruber* (L.) DC., a native of Europe, is sometimes cultivated for ornamental purposes in gardens in the mountains of Java.

#### Excluded

*Triplostegia* will be treated in this Flora under the *Dipsacaceae*, cf. p. 290.

## PONTEDERiaceae (C. A. Backer, Heemstede)

Halophobous, aquatic or palustrial perennial herbs, rooting in the mud or free-floating. Stem erect or floating, solid, with numerous air-chambers as are the petioles. *Leaves* rosulate or alternate, or solitary at the top of the stem, emersed, floating or submerged, broad or narrow, curvinerved (when emersed); petioles sheathing at the base. *Flowers* ♀, ephemeral, mostly in racemiform, spiciform, subumbelliform or paniculiform inflorescences which are subtended by 1–2 spathe-like or tubular leaf-sheaths, rarely solitary or pairwise in the leaf-axils. Bracts minute or absent. Flowers often simultaneously or centrifugally expanding. *Perianth* choriphyllous or gamophyllous, 6-merous, actinomorphic or zygomorphic, blue or lilac, rarely yellow, after anthesis marcescent and tightly including the ovary or the fruit. Stamens 6 or 3, rarely 1, on the base, in the tube or in the throat of the perianth, often unequal; filaments free; anthers 2-celled, cells bursting lengthwise, rarely opening by pores. Ovary superior, sessile, 3-celled, with axile placentas or 1-celled with 3 parietal or with 1 apical placenta. Ovules numerous or 1 and then pendulous from the apex of the cell. Style 1; stigma entire or minutely 3-lobed. *Fruit* a 3-valved capsule or indehiscent. Seed(s) longitudinally ribbed. Embryo central, terete, straight, hardly shorter than the copious, mealy endosperm.

Distr. About 8 small genera and  $\pm$  25 species, 6 genera confined to the New World, one in Madagascar, one widely distributed in the Old World; in *Malaysia* one native genus, one introduced and abundantly naturalized, and one occasionally cultivated as an ornamental.

Ecol. Inhabitants of fresh water.

Uses. Frequently used as potherbs.

Anat. O. SCHWARTZ in Beih. Bot. Centr. Bl. 42, 1. Abt. (1926) 263–320, 13 fig.

Note. As in many other waterplants the vegetative characters show a rather wide range of variability.

### KEY TO THE GENERA

1. Flowers distinctly pedicelled. Perianth actinomorphic, almost choriphyllous. Posterior tepal not with a discoloured blotch. Stamens 6; one mostly longer than the others. Filaments glabrous.  
**1. Monochoria**
1. Flowers sessile. Perianth strongly zygomorphic, very distinctly gamophyllous, posterior segment with a discoloured blotch. Stamens 3 or 6, and then 3 much larger than the others. Filaments, at least those of the longer stamens, hairy.  
**2. Eichhornia**
2. Tepals  $1\frac{1}{2}$  cm long or longer. Stamens 6; anthers dorsifixed. Inflorescences often with more than 10 flowers. Cultivated and often wild . . . . .
2. Tepals shorter than 1 cm. Stamens 3; anthers basifixed. Inflorescences 2–7-flowered. Exclusively cultivated; not further treated here . . . . . **3. Heteranthera (reniformis R. & P.)**

### 1. MONOCHORIA

PRESL, Rel. Haenk. 1 (1830) 127.—*Gomphima* RAFIN. Fl. Tell. 2 (1836) 10.

Glabrous, palustrial herbs, perennial or under unfavourable circumstances pseudo-annual, with long petioled radical *leaves*, and erect or obliquely erect stems arising from a suberect or creeping root-stock; each stem bearing at its top a single acute, densely curvinerved leaf, the petiole of which forms a prolongation of the stem. *Flowers* in terminal solitary, subsessile or shortly stalked, centrifugal, short or shortish, racemiform or subumbelliform inflorescences, which at first are hidden within the broad sheath of the cauline leaf, then burst forth, next bend forwards and after anthesis finally become quite deflexed. Inflorescence at the base, opposite the sheath of the floral leaf, with a large bract. Tepals 6, lilac blue with a green median nerve, free almost to the very base, spreading during anthesis, afterwards spirally contorted; 3 inner broader; median nerve of tepals thickened after anthesis.



Stamens 6 on the base of the perianth, subequal, or unequal: 5 with smaller yellow anthers, the sixth with a longer filament mostly provided with a lateral, obliquely erect tooth, its anther mostly larger, blue. All anthers basifixed, opening by a porelike slit. Ovary 3-celled, cells  $\infty$ -ovuled. Style filiform, stigma subentire or minutely 3-lobed. Ripe *capsule* exploding loculicidally into 3 valves which are torn from the pedicel and are flung away together with the many longitudinally ribbed seeds.

Distr. Three *spp.* in the Old World, from NE. Africa to Manchuria southward to S. Australia (*vide infra*), two of which in *Malaysia*.

Ecol. The Malaysian species are decidedly halophobous. They inhabit freshwater pools, ditches, canal-banks, and flooded paddy-fields.

Uses. All parts, barring the roots, frequently eaten as a vegetable.

Notes. Neither the *spp.* nor the sections distinguished by O. SCHWARTZ (*cf.* E. & P. ed. 2, 15a, 1930, 186) agree with my views. In both *M. hastata* and *M. vaginalis* the inflorescence is a pseudo-raceme, which is, specially in *M. hastata*, distinctly abbreviated, but occasionally provided with a manifest main axis. On the other hand *M. cyanea* distinctly differs from the two other *spp.* (except *M. hastata* var. *elata*) by distinctly spaced flowers, by equal anthers, and inappendiculate filaments. Therefore, I propose to divide the genus into two sections, *sect. Eumonochoria* O. SCHWARTZ (incl. *sect. Deutomonochoria* O. SCHWARTZ) and *sect. Limnostachys* (F.v.M., *pro gen.*) BACKER, *stat. nov.*

#### KEY TO THE SPECIES

1. Anthers equal. Filaments not provided with an obliquely erect tooth or appendage. **3. *M. cyanea***
1. Anthers unequal, one much larger than the others, its filament provided with a tooth or appendage.
2. Tillering, with a suberect or oblique, usually very short, rarely longish rootstock; old plants often forming dense tufts, but these tufts free from each other. Leaves of *adult* plants varying from broadly ovate to ovate-oblong from an obtuse, rounded, truncate or cordate but never sagittate or hastate base, up to 12½ cm long, often much smaller; basal lobes, if present, broadly rounded. Racemes 3–25-flowered. Flowers dark blue, mostly simultaneously expanded or nearly so. Pedicels 4–25 mm, rarely up to 40 mm. Perianth 11–15 mm long. Plant 5–50 cm high. . . . . **1. *M. vaginalis***
2. Rootstock of older plants well-developed, creeping, branched, so that these plants at last form large groups, the components of which are, or have been, subterraneously connected. Leaves of *adult* plants triangular-ovate, nearly always with a sagittate or hastate, very rarely with a cordate base, 7–25 cm by 4–20 cm; basal lobes divergent, mostly with an acuminate or narrowed apex. Racemes 15–60-flowered. Flowers pale blue, succedaneous in groups, so that the flowering is extended over a few days. Pedicels of the lower flowers 15–30 mm, of the higher 7–20 mm. Perianth 15–18 mm long. Plant 30–100 cm high, generally much more robust than the preceding species. . . . . **2. *M. hastata***

**1. *Monochoria vaginalis*** (BURM. f.) PRESL, *Rel. Haenk.* 1 (1827) 128; HASSK. *Pl. Jav. rar.* (1848) 106; MIQ. *Fl. Ind. Bat.* 3 (1859) 548; SUM. (1860) 269; ANN. MUS. L.B. 3 (1867) 143, *incl. var. minor* MIQ.; SOLMS in A.D.C. *Mon. Phan.* 4 (1883) 524, *incl. var. plantaginea* (ROXB.) SOLMS; RIDL. in FORB. *Nat. Wand.* (1885) 520; O.K. *Rev. Gen.* 2 (1891) 718; HOOK. f. *Fl. Br. Ind.* 6 (1892) 363; KOORD. *Minah.* (1898) 307; HUB. WINKL. *Bot. Jahrb.* 44 (1910) 526; KOORD. *Exk. Fl.* 1 (1911) 283; MERR. *Fl. Man.* (1912) 141; WISSE, *Trop. Natuur* 1 (1912) 171, f. 1; MERR. *Interpr. Herb. Amb.* (1917) 135; MERR. *En. Born.* (1921) 111; EN. PHILIP. 1 (1922) 200–201, *incl. var. pauciflora* (BL.) MERR.; BACK. *Handb. Fl. Jav.* 3 (1924) 40; RIDL. *Fl. Mal. Pen.* 4 (1924) 346; HOCHR. *Cand.* 2 (1925) 324, *incl. var. genuina*; HEYNE, *Nutt. Pl.* (1927) 435; BACK. *Onkr. Suiker.* (1928) 187, *Atl. t.* 199; OCHSE & BAKH. v. D. *Br. Veg.* (1931) t. 374, 375; CHERFILS, *Fl. gén.* I.C. 6 (1934) 818; BURK. *Ec. Prod.* 2 (1935) 1489; BACK. *Bekn. Fl. Java*, em. ed. 10 (1949) fam. 223, p. 2; STEEN. *Fl. Sch. Indon.* (1949) 135.—*Olus palustre* RUMPH. *Herb. Amb.* 6 (1750) 178, t. 75, f. 1.—*Pontederia vaginalis* BURM. f. *Fl. Ind.* (1768) 80; LINNÉ, *Mant.* 2 (1771) 228; BL. *En. Pl. Java* (1827) 32; DECNE, *Nouv. Ann. Mus.* 3 (1834) 362; SPAN. *Linnaea* 15 (1841) 477; MOR. *Syst. Verz.* (1845/46)

93; ZOLL. *Syst. Verz.* (1854) 66.—*Pontederia pauciflora* BL. *En. Pl. Java* 1 (1827) 32; MOR. *Syst. Verz.* (1845/46) 93; ZOLL. *Syst. Verz.* (1854) 66, *incl. var. minor*.—*Pontederia plantaginea* ROXB. *Fl. Ind.* ed. 2, 2 (1832) 123.—*Gomphima vaginalis* RAFIN. *Fl. Tell.* 2 (1836) 10.—*Pontederia linearis* HASSK. *Flora* 25, 2 (1842) Beibl. 1, p. 4; Cat. Bog. (1844) 28.—*Monochoria pauciflora* KUNTH, *En.* 4 (1843) 135; HASSK. *Pl. Jav. Rar.* (1848) 111; MIQ. *Fl. Ind. Bat.* 3 (1859) 549.—*Monochoria plantaginea* KUNTH, *En.* 4 (1843) 135; RIDL. *J. Bot.* 63 (1925) Suppl. p. 124.—*Monochoria ovata* KUNTH, *l.c.* 665; NAVES, *Nov. App.* (1880) 268.—*Monochoria junghuhniana* HASSK. *Flora* 35 (1852) 115; also *Nat. Tijd. Ned. Ind.* 8 (1855) 549.—*Monochoria linearis* MIQ. *Fl. Ind. Bat.* 3 (1859) 549.

Stems erect or obliquely erect. Leaves extremely variable as to shape and size, when adult mostly 2–12½ cm by ½–10 cm, in very young specimens entirely submerged without a distinct blade; leaf-top acuminate, very acute. Petioles broadly sheathing at the base, very variable as to length. Inflorescences soon deflexed, rather short, sometimes subumbelliform. Flowers of few-flowered inflorescences often unfolding simultaneously and all withering in the afternoon of the same day, of the many-flowered racemes opening centrifugally in



Fig. 1. *Monochoria hastata* (L.) SOLMS. Courtesy Pasuruan Exp. Station.

groups, so that the florescence extends over a few days. Perianth lilac blue. *Capsule* ellipsoid,  $\pm 1$  cm long. Seeds oblong,  $\pm \frac{5}{16}$  mm long, brown with  $\pm 10$  longitudinal, very thin ribs, between the ribs densely and very finely transversely striate.

Distr. SE. Asia to China, Japan and throughout *Malaysia*.

Ecol. From the plains up to  $\pm 1550$  m, as well in periodically very dry as in constantly humid regions, in swampy or inundated localities, along ditches, in shallow pools and especially in flooded paddy-fields, where the plant is often one of the commonest weeds, and, after the drying-out of the field, completely dies off, developing anew from seeds in the following inundation-period. In constantly swampy localities it can reach a higher age and attain rather large dimensions, though it never becomes so robust as well-developed specimens of the following species.

Uses. The entire plant, barring the roots, furnishes an excellent vegetable. The juice of the leaves and the roots is used for medicinal purposes.

Vern. Very many local names, the principal ones of which are: *Bengok*, *wèwèhan*, *J*, *biah biah*, *S*, *bira biraän*, *Md*, *ètjèng* (with various additions) *M*, *S*, Philippines: *Bigabigáan*, *gabing-uák*, *kalabúa* (Tag.), *gabi-gábi* (Bis.), *hahalung*, *hakhaklung* (If.), *bil-lagut*, *lapalápa* (Ilk.), *saksaklung* (Ig.), *saksakong* (Bon.), *lagtáng*, *upi-úpi* (Bik.). *Mal. Pen.*: *Kelayar*.

Note. Specimens with few-flowered inflorescences and small, often narrow, proportionally long leaves have wrongly been described as varieties or even separate species with one of the epithets *linearis*, *pauciflora* or *plantaginea*. They are either young or feeble, or were collected in deepish water.

See further the note under the following species.

The East Asiatic *M. korsakowii* REGEL and the NE. African *M. africana* (SOLMS) N.E.Br. are in my opinion racial varieties of *M. vaginalis* (BURM. f.) PR.

2. *Monochoria hastata* (L.) SOLMS in A.D.C. Mon. Phan. 4 (1883) 523; O.K. Rev. Gen. 2 (1891) 718; KOORD. Exk. Fl. 1 (1911) 283; MERR. Fl. Man. (1912) 141; MERR. Sp. Blanc. (1918) 95; En. Born. (1921) 111; BACK. Handb. Fl. Java 3 (1924) 41; Onkr. Suiker. (1928) 186, Atl. t. 198; OCHSE & BAKH. v. D. BR. Veg. (1931) 612, f. 373; BURK. Ec. Prod. 2 (1935) 1489; BACK. Bekn. Fl. Java, em. ed. 10 (1949) fam. 223, p. 2.—*Pontederia hastata* LINNÉ, Sp. Pl. (1753) 288; BURM. f. Fl. Ind. (1768) 80; BLUME, En. Pl. Java 1 (1827) 32; MOR. Syst. Verz. (1845/46) 102; ZOLL. Syst. Verz. (1854) 66.—*Pontederia dilatata* BUCH.-HAM. in SYMES, Emb. Ava (1800) 475, pl.; ANDR. Bot. Rep. 7 (1807) t. 490; ROXB. Fl. Ind. ed. 2, 2 (1832) 123.—*Monochoria hastaefolia* PRESL, Rel. Haenk. 1 (1827) 128; MIQ. Fl. Ind. Bat. 3 (1859) 548; SUM. (1860) 269; HOOK. f. Fl. Br. Ind. 4 (1892) 362; RENDLE, J. Bot. 39 (1901) 177; GIBBS in J.L.S. Bot. 42 (1911) 166; RIDL. Fl. Mal. Pen. 4 (1924) 344; CHERFILS, Fl. Gén. I.C. 6 (1934) 822.—*Pontederia sagittata* ROXB. Fl. Ind. ed. 2, 2 (1832) 124.—*Pontederia vaginalis*

(non BURM. f.) BLANCO, Fl. Fil. (1837) 255; ed. 2 (1845) 178; ed. 3, 1 (1877) 320, t. 466.—*Monochoria dilatata* KUNTH, En. 4 (1843) 134.—*Monochoria sagittata* KUNTH, l.c.—Fig. 1.

At an advanced age robust herb with erect or obliquely erect stems, up to 125 cm high; rhizome often long and strong, clothed with the remains of old sheaths. Petiole of radical leaves up to 60 cm long, of the floral leaves much shorter, its sheathing base much broadened. Inflorescences erect or suberect, at last horizontal or  $\pm$  deflexed, shortly stalked, dense. Pedicels erect or obliquely erect. *Perianth* somewhat lighter blue coloured than that of the preceding species. Filaments white. Top of the style densely patently short-hairy. *Capsule* ellipsoid,  $\pm 1$  cm long, Seeds oblong,  $\pm \frac{5}{16}$  mm long, brown, with  $\pm 10$  very thin longitudinal ribs, between the ribs densely and very finely transversely striate.

Distr. Tropical SE. Asia and throughout *Malaysia*, not yet recorded from the Moluccas & Lesser Sunda Islands.

Ecol. From the plains up to  $\pm 700$  m, in and along freshwater pools, on canal banks, on mud-flats in rivers, along irrigation-ditches, sometimes in paddy-fields though there much less frequent than the preceding species, locally often numerous, but, on the whole, much less common than the preceding species.

Uses. Almost all parts of the plant, barring the roots, furnish a relished dish.

Vern. Many local names: *Běbēngai* (N. Sumatra), *bēngai gondo* (W. Borneo), *bia bia*, *M*, *ètjèng* (with various additions), *M*, *S*, *labu labu kabangan* (Sumatra), *pingo*, *wéwéan*, *bengok*, *J*, Philippines: *Gabi-gábi*, *kosol-kosol*, *payau-páyau* (Bis.), *gabigabihan* (Tag.). *Mal. Pen.*: *chacha layar*, *kangkong ayer*, *Papua*: *maoa*.

Note. Herbarium specimens when not collected with the rhizome are difficult to distinguish from *M. vaginalis*, in the few cases they possess broadly rounded basal leaf-lobes instead of the typical acuminate or narrowed ones. Such specimens might be of hybrid origin.

*var. elata* (RIDL.) BACKER, stat. nov.—*Monochoria elata* RIDL. J. Str. Br. R. As. Soc. no 79 (1918) 99; Fl. Mal. Pen. 4 (1924) 345; HOLTUM, M.A.H.A. Mag. 5 (1935) 164, cum icon.

Robust, ca  $1\frac{1}{2}$  m tall. Leafblades reduced, narrow lanceolate-hastate. Inflorescence elongated, to 12 cm. Anthers 5 mm long, the 6th 8 mm long.

Distr. Lower Siam, in *Malaysia*: Malay Peninsula (Kedah).

Ecol. In rice-fields, fl. Nov. Flowers close at 14.30 hours; the inflorescence lasts several days; flowers pale blue as in *var. hastata*. Recommended for ornamental purpose in shallow water.

Note. A distinct variety, not differing specifically from *M. hastata*, apparently of local distribution. The anthers in *var. hastata* measure mostly 3 mm, the 6th 5 mm.

3. *Monochoria cyanea* (F.V.M.) F.V.M. Fragm. Phyt. Austr. 8 (1872) 44; BAILEY, Queensl. Fl. 5

(1902) 1645; ?CHERFILS in Fl. Gén. I.C. 6 (1934) 824.—*Limnostachys cyanea* F.v.M. Fragm. 1 (1858) 24.—*Monochoria australasica* RIDL. J. Str. Br. R. As. Soc. 79 (1918) 100.

Blade absent or ovate, acuminate, sometimes cordate at the base. Flowers distinctly spaced in a raceme, apparently opening simultaneously. Stamens equal or subequal, filaments without appendages. Stigma with distinctly protruding papillar appendages. Fruit apparently appressed to the rhachis. Seeds 2 by 1 mm, barrel-shaped, with 10-12 prominent ribs.

Distr. Trop. Australia, ?continental SE. Asia, might occur in *Malaysia*.

Notes. It is doubtful whether the records of CHERFILS from continental SE. Asia are right. *M. australasica* RIDL. belongs to this species; it appears to be a submerged or juvenile form. Seeds appear to be appreciably larger than in the other two species in which they are only 8-10-ribbed. Additional field observations are needed to verify whether *M. cyanea* possesses the same exploding mechanism of the fruit as is found in the two other species.

## 2. EICHHORNIA

KUNTH, En. 4 (1843) 129.—*Eichhornia* AUCT.

Aquatic herbs of sympodial structure, floating or creeping, rooting from the nodes; components of the sympodium annual or perennial. *Leaves* rosulate or alternate, often long-petioled, broadly ovate-rhomboid or linear-lanceolate. Inflorescence terminal, peduncled, spiciform, 2- to many-flowered, during anthesis erect, afterwards deflexed. *Perianth* zygomorphic or subactinomorphic, lilac blue, often with a yellow blotch, 6-fid, marcescent after anthesis. Stamens inserted in the throat of the corolla or deeper, decurved, unequal, often 3 longer, 3 shorter. Filaments inappendiculate, hairy in the Malaysian species. Anthers inserted near the base. Ovary sessile, 3-celled; cells many-ovuled. Style filiform. *Fruit* (never produced in Malaysia; not seen by me) membranous, many-seeded.

Distr. According to SOLMS, 5 spp. in tropical America; one of them naturalized in tropical Asia and elsewhere.

Ecol. Inhabitants of stagnant or slow-moving fresh water, often growing gregariously.

1. *Eichhornia crassipes* (MART.) SOLMS in A.DC. Mon. Phan. 4 (1883) 527; WIGMAN, Teysmannia 8 (1897) 353; *ibid.* 19 (1908) 621, *cum tab.*; BACK. Ann. J.B.B. Suppl. 3 (1909) 400; KOORD. Exk. Fl. 1 (1911) 284; VAN WELSEME, Trop. Natuur 1 (1912) 2-5, 31, 57-60, *cum tab.*, 62; KOENS, *ibid.* 2 (1913) 14, 96, 111; BEUMÉE, Trop. Natuur 7 (1918) 94; WITKAMP, *ibid.* 8 (1919) 30, 110; *ibid.* 14 (1925) 157; MERR. En. Born. Pl. (1921) 111; En. Philip. 1 (1922) 200; KOORD. Exk. Fl. Atlas (1923) 218, f. 440; BACK. Handb. Fl. Jav. 3 (1924) 42; WITKAMP, Trop. Natuur 14 (1925) 157, *cum tab.*; HEYNE, Nutt. Pl. (1927) 435; BACK. Onkr. Suiker. (1928) 187, Atl. t. 200; RIDLEY, Disp. Pl. (1930) 231; OCHSE & BAKH. v. d. BR. Veg. (1931) 610, t. 372; DE VOOGD, Trop. Natuur 21 (1932) 62, f. 7; CHERFILS. Fl. Gén. I.C. 6 (1934) 826; BURK. Dict. 1 (1935) 891; PENFOUND & EARLE, Ecol. Mon. 18 (1948) 447-472; BACK. Bekn. Fl. Java em. ed. 10 (1949) fam. 223, p. 2; STEEN. Fl. Sch. Indon. (1949) 135; VAAS, Contr. Gen. Agr. Res. Sta. no 120 (1951) 3-59.—*Pontederia crassipes* MART. Nov. Gen. Sp. (1823) 9, t. 4.—*Eichhornia speciosa* KUNTH, En. 4 (1843) 131.—*Heteranthera formosa* MIQ. Linnaea 5 (1843) 61.—*Piaropus crassipes* BRITTON, Ann. N.Y. Ac. Sc. 7 (1893) 241.—Fig. 2-3.

Floating herb with a very short leafy main-stem, sending down a large bunch of long fibrous roots, in very shallow water sometimes rooting in the mud, 30-50 cm high (in flower), rarely higher,

emitting axillary, moderately long stolons the top of which grows out into a new plant, which readily separates from the mother-plant and begins an



Fig. 2. *Eichhornia crassipes* (MART.) SOLMS at Djombang, E. Java (DE VOOGD).



Fig. 3. *Eichhornia crassipes* (MART.) SOLMS at Djombang, E. Java (DE VOOGD).

independent life. *Leaves* radical, rosulate, emerged. Petioles spongy: in young specimens short and very much swollen in or below the middle, in adult ones much longer, up to 30 cm long, tapering almost from the base. *Leafblade* broadly ovate or rhomboid from a shallowly cordate, truncate, rounded or broadly cuneate base, very obtuse, finely and densely curvined, firmly herbaceous, quite glabrous, 7–25 cm long and wide. Inflorescences long-peduncled, peduncle with two closely approximate bracts: lower bract with a long tubular sheath and a small blade, upper bract almost entirely enclosed by the sheath of the lower, for the greater part tubular, apiculate. Flower-bearing axis very angular, up to 15 cm long, often much shorter. *Flowers* per inflorescence 3–35, usually simultaneously expanding and withering, very showy, said to be trimorphous (in Malaysia only a form occurs with 3 very short anterior filaments, the 3 other much longer; stigma at medium height between the anthers of the long and the short filaments). *Perianth-tube*  $1\frac{1}{2}$ – $1\frac{3}{4}$  cm long, with a green base and a pale top, slightly curved; segments ovate to oblong or obovate, lilac; posterior segment with a bright yellow, blue-bordered median blotch, 3– $3\frac{1}{4}$  cm long; more forward placed segments gradually smaller. Stamens curved; filaments glandular hairy. Style glabrous; stigma hairy. *Fruit* never produced in Malaysia.

*Distr.* Native of Brazil, introduced and naturalized in several other tropical countries, e.g. SE. Asia, Queensland, Guam, &c., in *Malaysia*: Sumatra, Malay Peninsula, Java, Borneo, Philip-

pines. In 1894 introduced in the Buitenzorg Botanic Gardens, where it thrived exceedingly well and by its exuberant growth soon became a nuisance. Cart-loads of it were thrown in the Tji Liwung (river which crosses the Botanical Gardens) and were carried downwards by it to waters in the plains; it was also sent out as an ornamental or as a surface-covering for fishponds. At present spread from the plains up to  $\pm$  1600 m. About 1902 it appeared in several places in continental SE. Asia; in the Philippines it was introduced as an ornamental about 1912.

*Ecol.* Inhabits stagnant or slow-moving fresh water such as broad rivers near their banks, lakes, canals, railway-ditches, morasses, pools, tanks; exceptionally and only temporarily on inundated paddy-fields. By its luxuriant growth and extremely rapid propagation the plant has become locally a very troublesome weed, covering entirely the surface of the water, crowding out all other plants, choking watercourses and greatly hampering water-traffic and fishing. At present it is tried to eradicate this pest by spraying with chemicals (VAAS, *L.c.*). By a sudden rush of rising water, caused by heavy rains, great masses of it may be torn loose, forming, as it were, floating islands, which are carried by rivers to the sea where they immediately die off.

*Uses.* Besides for the purposes mentioned above the plant is used as a manure and for fattening pigs. Young leaves, petioles and inflorescences are sometimes used as a vegetable.

*Vern.* Many names. The principal of these are:

*Waterhyacinth(h)*, D, E, *bia bia*, M, *ètjèng* (with various additions), M, S, *gèndot*, S, *ilung ilung*, *mampau*, *mampoh*, *nappong*, *béngai gondo* (Born.), *sěkar bopong*, *wéwéhan*, *běngok*, J. Mal. Pen.:

*kěměling tělur*, *kěladi bunting*, *bunga jamban*.

Note. The plant often displays gregarious flowering and presents than a very beautiful spectacle. It contains much potash.

#### Excluded

*Monochoria dubia* (BL.) MIQ. Fl. Ind. Bat. 3 (1859) 549, based on *Pontederia dubia* BL. En. Pl. Java 1 (1827) 33 = *Hydrocharis dubia* (BL.) BACK. Handb. Fl. Jav. 1 (1925) 64 (Syn. *Hydrocharis asiatica*

MIQ. Fl. Ind. Bat. 3, 1856, 239); cf. also HALLIER f., Nova Guinea 8 (1913) 917; DANDY, J. Bot. 70 (1932) 328.

# CORYNOCARPACEAE (C. G. G. J. van Steenis, Leyden)

## 1. CORYNOCARPUS

FORST. Gen. Pl. (1776) 32, t. 16; DC. Prod. 8 (1844) 145; HOOK. f. Bot. Mag. (1848) t. 4379; Fl. Nov. Zel. 1 (1852) 48; B. & H. Gen. Pl. 1 (1862) 425; E. & P. Nachtr. (1897) 215; TIEGH. J. de Bot. 14 (1900) 193; HEMSL. Ann. Bot. 17 (1903) 743, t. 36; *ibid.* 18 (1904) 179; STEEN. Bull. J.B.B. III, 13 (1933) 99, f. 1; J. KRAUSE in E. & P. ed. 2, 20b (1942) 22.

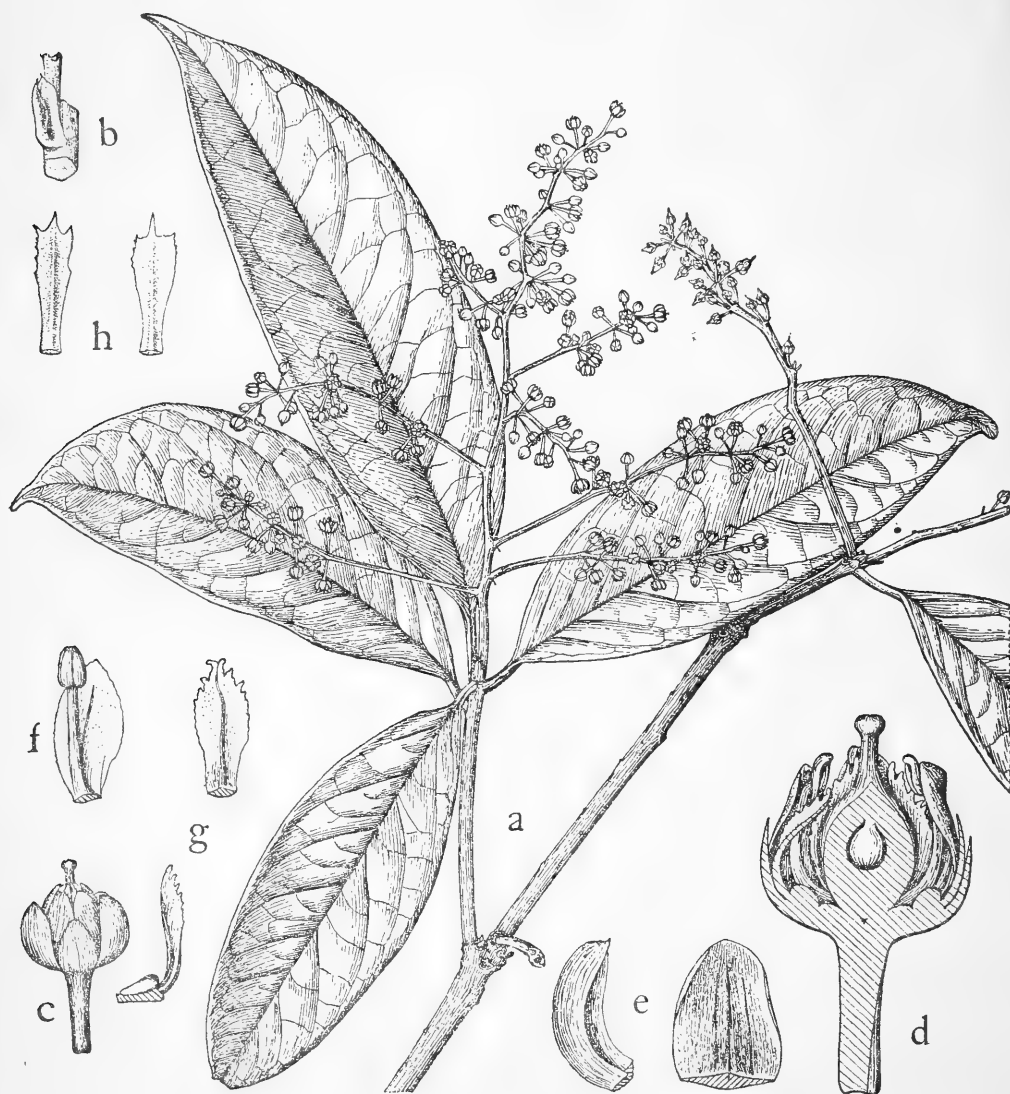


Fig. 1. *Corynocarpus australasica* C. T. WHITE. a. Flowering branch,  $\times \frac{1}{2}$ , b. insertion of a lower branch of panicle, with 2 adnate bracts, c. flower, d. section of flower, e. sepal, inner and lateral side, f. petal and adnate stamen, g. staminodes, the lower with the basal gland, h. staminodes from fresh material; b-h. enlarged (drawn after C.H.B.: V.B. 83).



Evergreen, glabrous trees or shrubs, without resin-tubes. *Leaves* spread, simple, entire, more or less crowded towards the ends of the shoots, shining, exstipulate; midrib sulcate; shoots with perular terminal buds. Branches often in pseudo-whorls. Inflorescences terminal, sometimes lateral, generally not exceeding the leaves. *Flowers* on the ultimate axis in fascicles of 3, towards the end solitary, pedicellate, bracteate. *Calyx* deeply 5-lobed, fleshy, persistent, petaloid, lobes unequal, concave, imbricate, 2 outermost smallest. Petals 5, thinner than the sepals, inserted at the margin of the disk-like receptacle. *Stamens* 5, attached to the base of the petals; filaments flattened or terete, slightly thickened towards the base; anthers dorsifixed, dehiscent lengthwise, introrse. *Staminodes* petaloid, dentate in the upper half, top mostly pointed, alternating with the petals. *Disk glands* 5, ovoid to ellipsoid, epistaminodial. *Ovary* ovoid, originally 2-celled, one cell soon abortive. *Styles* 1–2; stigma punctiform. *Ovule* 1, pendulous, anatropous. *Fruit* drupaceous, or a nut, with fibrous endocarp. *Testa* membranous; cotyledons plano-convex; albumen absent.

*Distr.* Four spp., one each in New Zealand and adjacent islands, N. Caledonia, the New Hebrides, and N. Queensland & E. Malaysia.

*Uses.* In New Zealand the fleshy exocarp and the seeds of *C. laevigata* FORST. are found edible by the Maori tribe, the prune-like fruit being prepared before, to remove some prussic acid containing glucosids. By its big fruit the New Guinean species is promising as a food plant, but nothing is definitely known about its properties.

*Notes.* Both ENGLER and HUTCHINSON place this monogeneric family in the *Celastrales* or *Celastrineae* but WETTSTEIN in the *Terebinthales*; HALLIER f. finally included them in the *Rosaceae*.

**1. *Corynocarpus australasica* C. T. WHITE, Contr. Arn. Arb. 4 (1933) 57, t. 5; STEEN. Bull. J.B.B. III, 13 (1933) 101; MERR. & PERRY, J. Arn. Arb. 22 (1941) 541; STEEN. *ibid.* 28 (1947) 421.—*Corynocarpus* sp. Bull. J.B.B. III, Suppl. (1930) 82.—Fig. 1, 2.**

Small to medium-sized tree, 4–12 m; branchlets angular, their bark grey. *Perular bracts* thick, triangular, acute, warty, persistent, outer ones 4–6 by 3–4½ mm, inner ones narrower. *Leaves* elliptic-oblong, distinctly acute, mostly falcate-acuminate, base cuneately narrowed into the sulcate petiole 1–2 cm, 9–22 by 3–9 cm. *Nerves* ca 9–11 pairs, erect, curved, anastomosing near the margin, impressed above, prominent below as is the stout midrib; parenchyma with whitish-crystal dots. *Panicle* broadly pyramidal, 6–16 cm long, 5–25 cm broad; axis angular, primary branches bracteate. *Flowers* fragrant, whitish, tips of the petals slightly rosa, after flowering the whole flower distinctly rosa, flower parts long-persistent. *Sepals* broadly elliptic with rounded tip, after blossoming very concave, 2 outer 1¾–2½ by 1¼–2 mm, inner ones 2½–3½ by 2 mm, 3-veined. *Petals* obovate-oblong to elliptic, 2½–3¼ by 1½ mm long, with 1 vein. *Filaments* terete, white, 1½–2¼ mm long; *anthers* brownish, later darkbrown, acute-ovate, ⅔ mm long, lower half of the cells free. *Staminodes* obovate-oblong, 2½–3 mm long. *Disk-glands* yellowish or yellow-green. *Ovary* green, ca 1 mm high; *style* 1, sometimes obliquely inserted, little over 1 mm; *stigma* greenish-brown, punctiform. *Receptacle* developed as a flat disk between the ovary and the insertions of the sepals, connate with the bases of the petals. *Fruit* a nut,

not fleshy, globular to broad-elliptic but variable in shape, pointed at both ends; pericarp hard, irregularly shallow-ribbed, 3–5 by 3¼–3½ cm, greyish-green to red; exocarp 2 mm diam.; endocarp woody, closely adhering, inside smooth with

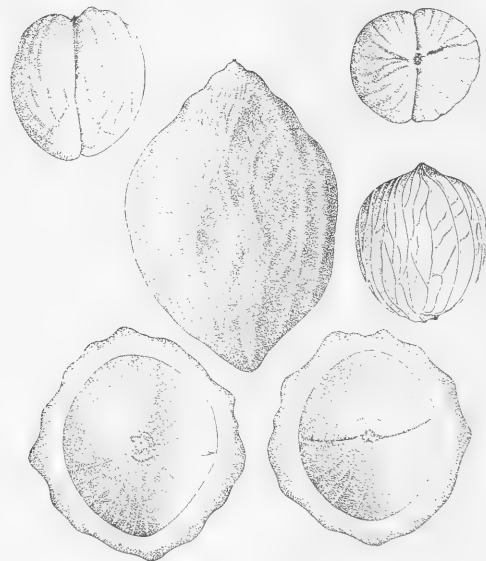


Fig. 2. Fruit of *Corynocarpus australasica* C. T. WHITE,  $\times \frac{3}{4}$ . Centre: outside; bottom: halved pericarp, inside; right: seed with testa; top: testa removed (drawn after bb 22121).



irregular ribs and a furrow in the apical half, purple, 2 mm thick. Testa membranous, prominently lengthwise veined. Embryo hard, oblique, bony, with a longitudinal groove between the cotyledons,  $2\frac{1}{2} \times 2\frac{1}{2} \times 2$  cm.

Distr. N. Queensland, in *Malaysia*: New Guinea and S. Moluccas (Aru Islands).

Ecol. Rainforest substage tree, apparently not rare in New Guinea, up to 1800 m, *fl.* Oct., *fr.* June–Oct.

## MYOPORACEAE (S. Bloembergen, Bogor)

### 1. MYOPORUM

BANKS & SOL. *ex* FORST. Prod. (1786) 44; R.BR. Prod. (1910) 515; BTH. Fl. Austr. 5 (1870) 2; F.v.M. Descr. & Ill. Myop. Pl. Austr. (1886) t. 56-72; BAIL. Queensl. Fl. (1901) 1154.

Shrubs, trees, or prostrate plants. *Leaves* spread, rarely opposite, entire or toothed, exstipulate. *Flowers* ♂, zygomorphic, rarely almost actinomorphic, small, axillary, solitary or usually in clusters of 2, 3 or more. Calyx and corolla 5-lobed. Stamens 4, rarely 5, in pairs of unequal length, inserted on the corolla-tube and alternate with the lobes. Anther-cells opening lengthwise, confluent at the apex, usually forming a single reniform cell after dehiscence. Ovary superior, not lobed, 2-10-celled with 1 ovule in each cell, rarely 2-celled with 2 ovules per cell. Style simple entire or obscurely notched at the apex. *Drupe* 2-10-celled.

Distr. *Ca* 35 spp., largely in Australia, 1 species in E. Asia, further in the Pacific, Rodriguez Isl. and Mauritius.

Ecol. Most representatives are heliophilous and thermophilous; many are drought plants.

Notes. The *Myoporaceae* are centering in Australia; their affinity is generally accepted in the *Tubiflorae* with *Plantaginaceae*, *Scrophulariaceae*, etc.

1. *Myoporum papuanum* KRAENZL. in FEDDE, Rep. 22 (1926) 338; *ibid.* Beih. 54 (1929) 14; BLOEMB. Blumea 3 (1938) 180.—*M. tenuifolium* (non FORSTER 1786) VAL. Bull. Dép. Agric. Ind. Néerl. 10 (1907) 61.—*M. acuminatum* HEMS. Rep. Chall. Exp. Bot. 1, 3 (1884) 175; WARB. Rumph. Gedenkb. (1902) 75, *non al.*—Fig. 1.

Treelet up to 3 m. *Leaves* lanceolate, acute to subacuminate, attenuate into the 4-10 mm long petiole, glabrous, entire, penninerved,  $3\frac{1}{2}$ -10 by  $1\frac{1}{2}$ -1 $\frac{1}{2}$  cm. *Flowers* white, 2-6 axillary; pedicels 5-11 mm. Calyx nearly regular, glabrous (4-)-5-merous, cup-shaped tube  $\frac{1}{4}$ - $\frac{1}{2}$  mm high,  $1\frac{1}{2}$ -1 $\frac{3}{4}$  mm wide, segments narrow-triangular 1-1 $\frac{3}{4}$  mm long, often strongly acuminate towards the acute apex. Corolla nearly regular (4-)-5(-6)-merous, entirely glabrous, tube campanulate-infundibuliform 3-4 $\frac{1}{4}$  mm high, 3-4 mm wide; lobes spreading rounded at the apex,  $1\frac{3}{4}$ -2 $\frac{1}{2}$  mm long,  $1\frac{1}{2}$ -2 mm broad. Stamens (3-)-4(-5), glabrous, 2 longer ones 3-3 $\frac{1}{4}$  mm long, shorter ones 2 $\frac{1}{4}$ -3 $\frac{1}{4}$  mm long, inserted resp. nearly in the middle and somewhat below the middle of the tube. Anthers  $\frac{1}{2}$ -1 mm long. Ovary ovoid, conical towards the apex, 3-4-celled,  $1\frac{1}{2}$ -3 mm long, 1-1 $\frac{1}{2}$  mm diam. Style terete 2-3 $\frac{1}{2}$  mm long; stigma short flat. *Drupe* ovoid, red-brown or purple, 3-4-celled, glabrous, up to 4 $\frac{1}{2}$  mm long, 4 mm diam., crowned by the persistent style or style rest.

Distr. ?Micronesia, ?Queensland, in Malaysia: New Guinea and S. Moluccas (Tanimber Islands = Timor laote).

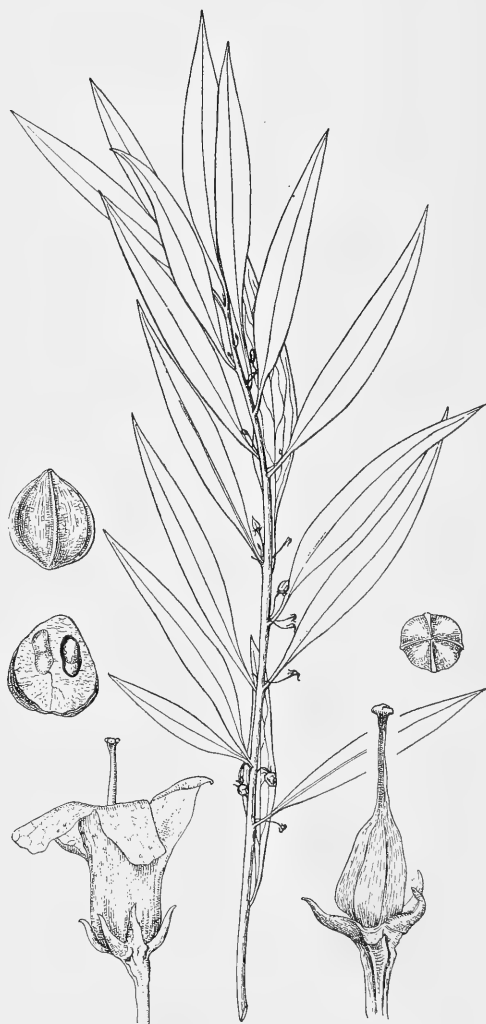


Fig. 1. *Myoporum papuanum* KRAENZL. Flowering twig,  $\times \frac{1}{2}$ , flowers,  $\times 5$ , drupes,  $\times 2$ .

Ecol. Rare, near the coast, in savannahs, grass-fields, and open forests.

Notes. This species may prove to be a geographical variation of some polymorphic Australian population, presumably of *M. acuminatum* BTH.. BRASS 8848, found near Jotefa (Jautefa) Bay,

differs by recurved fruiting pedicels, a bearded corolla throat, and purple drupes. It occurred abundant on limestone shores. It is scarcely separable from some Queensland specimens (CLEMENS *a.* 1944, VICKERY 15.11.36, and HUBBARD 6649).

## AIZOACEAE (C. A. Backer, Heemstede)

Annual or perennial herbs or undershrubs, sometimes fleshy. *Leaves* simple, entire or subentire, opposite, spread, or spuriously whorled, sometimes minute, stipulate or not. Stipules often small, scarious, fugacious. *Flowers* axillary, solitary, clustered or fascicled, cymose, pseudoracemose, or subumbellate, actinomorphic, usually ♀, often small and inconspicuous. *Tepals* 5, either free, imbricate in bud, herbaceous with scarious often white margins or entirely scarious, persistent, conniving before and after anthesis, or a distinctly gamophyllous, corolline or calycine 3–8-lobed perianth with usually persistent, herbaceous lobes imbricate or rarely valvate in bud. *Stamens* 1–∞, perigynous or hypogynous, free or connate at the base, either singly or in groups, often alternate with the perianth lobes. Anthers 2-celled, dehiscent lengthwise. Disk annular or absent. Ovary superior, semi-inferior or inferior, 1–9-celled. Ovules 2–∞, solitary or ∞, basal, apical or axile. Styles 1–∞. Capsule or drupe, 2–∞-seeded, often enclosed by the perianth and falling off with it.

**Distr.** About 23 genera (if *Mesembryanthemum* is split into segregates many more) and over a thousand *spp.* (over 800 belonging to *Mesembryanthemum*), distinctly centering in the S. hemispherical subtropics of the Old World, mainly in S. Africa, with a secondary centre of development in Australia, in *Malaysia* and other essentially forested tropics poorly represented by some widely distributed, partly peritropical genera and widely distributed weeds.

**Ecol.** On the whole preferring arid or periodically dry often sandy country, some maritime (*Sesuvium*, *Trianthema*).

**Uses.** Some vegetables (*Tetragonia*), some used for extracting potash, many ornamentals (*Mesembryanthemum*).

**Notes.** By some authors this family has been split into two separate families mostly called *Molluginaceae* (with a free perianth) and *Ficoidaceae* (with a gamophyllous perianth) but in my opinion this is unnecessary.

By some authors *Aizoaceae* have been merged with *Portulacaceae*. The Malaysian representatives of this allied family can easily be recognized by the presence of two connate or free distinct sepals outside the corolla and a 1-celled ovary.

### KEY TO THE GENERA

1. Tepals 5, free.
  2. Seeds estrophiolate. Flowers in terminal cymes or pseudoracemes or in stalked umbels. Leaves narrow, glabrous . . . . . **1. Mollugo**
  2. Seeds distinctly strophiolate, strophiole with a long filiform appendix which is curved round the seed and closely resembles a funicle but is not attached to the placenta. Flowers in axillary fascicles. Leaves mostly not very narrow, often hairy . . . . . **2. Glinus**
1. Perianth 3–8-lobed, gamophyllous, corolline or calycine.
  3. Leaves opposite or spuriously whorled. Ovary superior. Fruit dehiscent by an operculum.
    4. Styles 3–4. Flowers solitary in the leaf axils, distinctly stalked. Leaves comparatively narrow . . . . . **3. Sesuvium**
    4. Styles 1–2 . . . . . **4. Trianthema**
  3. Leaves spread. Ovary semi-inferior. Fruit indehiscent . . . . . **5. Tetragonia**

### 1. MOLLUGO

LINNÉ, Sp.Pl. 1 (1753) 463; Gen. Pl. ed. 5 (1754) no 99.

Erect or diffuse, slender, glabrous herbs, mostly annual. *Leaves* spuriously verticillate or partly subopposite, lanceolate, linear-lanceolate or for a greater or smaller part obovate-subspathulate, entire. *Flowers* small, in terminal cymes which often end in pseudoracemes or in stalked umbels; single flowers pedicelled. Tepals herbaceous, with scarious, often white margins. Stamens 3–5, alternating with the tepals, less often 6–10, free; filaments filiform, rarely (not in *Malaysia*) dilated in the middle. Ovary ovoid or broadly ellipsoid, 3-celled. Styles 3, filiform. *Fruit*, when falling off, leaving the persistent pedicel. Seeds estrophiolate; testa granulate or faintly reticulate; embryo annular.

Distr. Species  $\pm 15$ , distributed over the warmer regions of the globe, extending into Europe and N. America, in *Malaysia* thus far only one species; a second may be discovered.

Ecol. Mostly in settled areas as a weed of cultivation or in open or waste places.

Uses. Used as a potherb or for medicinal purposes.

Note. The distinction between the genera *Mollugo* and *Glinus* has been exposed by FENZL (Ann. Mus. Wien 1, 1836, 346–353, 372) who found an essential difference in the structure of the seeds. BENTHAM & HOOKER f. (Gen. Pl. 1, 1867, 857) hold this character insufficient, and some subsequent authors share this opinion, e.g. WILSON (N. Am. Fl. 21<sup>4</sup>, 1932, 268), and the late Dr P. J. EYMA, whose notes have been used to complete this revision. EYMA's argument is that plants showing a very close resemblance are now assigned to two different genera, *Glinus* and *Mollugo*, merely on the strength of the seed structure which might be an artificial means of dividing what ought to be kept together. However, this was known to FENZL (*l.c.* p. 372), and I do not agree with EYMA.

#### KEY TO THE SPECIES

1. Ripe seeds very distinctly granulate. Leaves often more than 3 mm wide . . . 1. *M. pentaphylla*
1. Ripe seeds not at all granulate but very faintly reticulately ribbed. Leaves less than 3 mm wide . . . 2. *M. cerviana*

1. *Mollugo pentaphylla* LINNÉ, Sp. Pl. (1753) 89; BURM. f. Fl. Ind. (1768) 31; SER. in DC. Prod. 1 (1824) 391; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1064; MERR. Sp. Blanc. (1918) 141; EN. BORN. Pl. (1921) 246; RIDL. Fl. Mal. Pen. 1 (1922) 867; MERR. En. Philip. 2 (1923) 135; HOCHR. Candollea 2 (1925) 356, incl. var. *stricta* (L.) HOCHR.; HEYNE, Nutt. Pl. (1927) 611; BACK. Onkr. Suiker. (1930) 238, Atl. t. 248; OCHSE & BAKH. v. D. BR. Veg. (1931) 4, f. 3; BURK. Dict. (1935) 1484; MERR. & PERRY, J. Arn. Arb. 23 (1942) 386; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 57, p. 1; HEND. Mal. Wild Fl. 1 (1949) 172, f. 165.—*M. stricta* LINNÉ, Sp. Pl. ed. 2 (1762) 131; BURM. f. Fl. Ind. (1768) 131, t. 5, f. 3; SER. in DC. Prod. 1 (1824) 391; BLUME, Bijdr. (1825) 62; DECNE, Nouv. Ann. 3 (1834) 429; BLANCO, Fl. Fil. (1837) 52; ed. 2 (1845) 35; ed. 3, 1 (1877) 64; SPAN. Linnaea 15 (1841) 167; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1064, Sum. (1860) 150; BRITTEN in FORB. Nat. Wand. (1885) 506 (*sphalmate: striata*); F.V.M. Not. Pap. Pl. 8 (1888) 43; KOORD. Exk. Fl. 2 (1912) 206; WINKL. Bot. Jahrb. 49 (1913) 369.—*M. sumatrana* GAND. Bull. Soc. Bot. Fr. 65 (1918) 29.

Glabrous throughout, often much and widely branched (frequently from the very base), annual, with a thin main root, 2–35 cm high, erect or with prostrate main-branches, when old often tinged brownish red. Stem thin, angular. Leaves usually in false whorls of 3–9, mostly 3–5, not rarely partly opposite, entire, pale beneath, 10–50 by 1½–10 mm; lowermost ones (often disappearing before anthesis)  $\pm$  rosulate, oblong-obovate-spathulate, distinctly petioled; higher leaves rarely of the same shape, mostly lanceolate or linear-lanceolate from a narrowed acute base, shortly petioled or sessile, acute; midrib prominent beneath. Flowers in terminal or leaf-opposed peduncled lax cymes with often long racemiform ultimate branches. Bracts small, persistent. Pedicels erecto-patent, thin, 1½–6 mm, persistent and decurved till long after the fall of the fruiting perianth. Tepals oval-oblong, obtuse, inside white, outside green with white margins, at an advanced age often turning brown, 1¼–2 mm long, during anthesis (in sunny morning-hours) widely patent, afterwards conniving to a globe. Stamens 3; filaments filiform, not

dilated in the middle, short. Styles white. Capsule broadly ellipsoid, faintly 3-lobed,  $\pm 2$  mm long. Seeds reniform, darkbrown, finely granulate,  $\pm 3/4$  mm diam.

Distr. Tropics and subtropics of the Old World, apparently very rare in Australia; throughout *Malaysia*, also in New Britain, Micronesia, New Caledonia.

Ecol. In dry as well as in moist regions, mostly in settled areas, often in sandy or stony localities, sometimes on old lava-streams (Ternate), 5–1200 m, fields, gardens, premises, open places, teak-forests, locally often abundant.

Uses. Eaten as a potherb and used for medicinal purposes.

Vern. Java: *Djukut kulut*, *dj. taridi*, *dj. said*, *dj. titiran*, *S. galingsa*, *J.*, moreover several local names; in the medicine-trade sold under the name of *daun mutiara*. Philippines: *Lepouo* (Bon.), *mala-goso*, *mali-goso* (Tag.), *pisig-pisig* (Bag.), *salsalida* (Bis.), *sudlai*, *sulangkang* (Sub.).

Note. BOORSMA found a saponin in it and much saltpetre. Its small dimensions make it worthless as a fodderplant.

2. *Mollugo cerviana* (LINNÉ) SER. in DC. Prod. 1 (1824) 392; BTH. Fl. Austr. 3 (1866) 334; BAIL. Queensl. Fl. 2 (1900) 712; KOORD. Exk. Fl. 2 (1912) 206.—*Pharnaceum cerviana* LINNÉ, Sp. Pl. (1753) 272; BURM. f. Fl. Ind. (1768) 76.

Glabrous, glaucous annual, usually pluricauline, 3–20 cm high, with an often longish but not thick main-root. Stems mostly numerous from a broad root-crown, erect, erecto-patent or prostrate, very slender, with somewhat thickened nodes, frequently much branched. Radical leaves (often withering before anthesis) rosulate, linear, linear-narrowly lanceolate or subspathulate from a narrowed base, 5–30 mm long. Cauline leaves in spurious whorls of 3–8 or higher ones opposite, sessile or very shortly petioled, narrowly linear or subspathulate from a narrow base, obtuse or obscurely apiculate, 6–18 by 1–1¼ mm. Peduncles subumbellate or solitary at the tops of the branches, rather long, thin, stiffish. Flowers in lax pseudoracemes or 2–4 subumbellate at the ends of the peduncles. Pedicels erect or patent, filiform, stiffish, 6–18 mm long.

Tepals patent during anthesis, before and after anthesis erect, oval-oblong, with an obtuse or rounded apex, with broad, white scarious margins,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long. Stamens 3–5; filaments longish, filiform. Styles erecto-patent or spreading, hardly  $\frac{1}{4}$  mm long, comparatively thickish. *Capsule* broadly ellipsoid, equalling the perianth. Seeds closely packed, reniform-subsemiorbicular, brown, not granulate but laxly and slightly prominently, irregularly reticulately ribbed, less than  $\frac{1}{2}$  mm long.

Distr. S. Europe, tropical and S. Africa, S. to

SE. Asia, Ceylon, and Australia, not yet recorded from *Malaysia*, but, considering the general distribution, possibly occurring there somewhere.

Ecol. Dry regions at low altitudes, often in sandy localities.

Uses. According to TRIMEN (Fl. Ceyl. 2, 1894, 272) in Ceylon much used as a medicine against fever. FENZL (Ann. Wien. Mus. 2, 1839, 304) states that according to a manuscript note in BURMAN's herbarium the plant is used in Hindustan as a remedy for bilious fever and syphilis.

## 2. GLINUS

LINNÉ, Sp. Pl. (1753) 463; Gen. Pl. ed. 5 (1754) no 537.—*Tryphera* BL. Bijdr. (1825) 549.

Diffuse, glabrous or hairy, often much branched annuals. *Leaves* opposite or spuriously whorled, oblong, oval, ovate, obovate or spatulate, entire or obscurely dentate. *Flowers* axillary in few-flowered clusters or fascicles, pedicelled or subsessile. Tepals with scarious, frequently white margins, often unequal. Stamens 3–20, free or, when numerous, fascicled, in the Malaysian specimens usually 3–15 and free; filaments filiform. Ovary oval or oblong, 3–5-celled. Styles erect, spreading or recurved, linear or oblong-elliptic, persistent. *Capsule* 3–5-valved. Seeds ∞, distinctly strophiolate; strophiole with a long, thin appendix encircling a considerable part of the seed and resembling a funicle but not attached to the placenta; testa finely granulate.

Distr. Probably about 10 *spp.* in the tropics and subtropics of both hemispheres, elsewhere sometimes introduced.

Ecol. The 2 Malaysian *spp.* inhabit by preference dried-up pools and ditches and fallow rice-fields, less often waste places. They often grow gregariously and intermixed.

Uses. Sometimes used for medicinal purposes.

Note. For the distinction of *Mollugo* and *Glinus* see the notes under the former genus.

### KEY TO THE SPECIES

1. Tepals acute, outside usually with many stellate, white hairs, often densely woolly, 6–10 mm long. Stamens 5–15, rarely more. Styles usually 5, linear, erect or erecto-patent,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long. Capsule usually 5-valved. Flowers often sessile or subsessile. . . . . 1. *Gl. lotoides*
1. Tepals obtuse, glabrous or thinly pubescent outside, 3–5 mm long. Stamens 3–4. Styles 3, less often 4, oval-oblong, widely patent or recurved, less than  $\frac{1}{2}$  mm long. Capsule 3-, less often 4-valved. Flowers always very distinctly (4–15 mm) pedicelled . . . . . 2. *Gl. oppositifolius*

1. *Glinus lotoides* LINNÉ, Sp. Pl. (1753) 463; BURM. f. Fl. Ind. (1768) 112, t. 36, f. 1; DC. Prod. 3 (1828) 455; BLANCO, Fl. Fil. (1837) 413, ed. 2 (1845) 288, ed. 3, 2 (1878) 169; ZOLL. Syst. Verz. (1854) 141; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1063, Sum. (1860) 150; KOORD. Exk. Fl. 2 (1912) 206; BACK. Onkr. Suiker. (1930) 239, Atl. t. 249; BEKN. Fl. Java, em. ed. 4 (1942) fam. 57, p. 2.—*Gl. dictamnoides* LINNÉ, Mant. 2 (1771) 243; DECNE, Nouv. Ann. 3 (1834) 449; SPAN. Linnaea 15 (1841) 207.—*Mollugo hirta* THUNB. Prod. Fl. Cap. 1 (1794) 24; SER. in DC. Prod. 1 (1824) 391; F.-VILL. Nov. App. (1880) 100; VIDAL, Plant. Cuming. Philip. (1885) 16; Rev. Pl. Vasc. Filip. (1886) 144.—*Tryphera prostrata* BL. Bijdr. (1825) 549; ZOLL. Syst. Verz. (1854) 141 (*sphalmate: Triphera*); DC. Prod. 13, 1 (1859) 423, 424.—*Pharnaceum pentagynum* ROXB. Fl. Ind. ed. CAREY 2 (1832) 103.—*Glinus astrolasion* ZIP. ex SPAN. Linnaea 15 (1841) 207.—*Mollugo glinus* A. RICH. Fl. Abyss. 1 (1847) 48.—*Mollugo lotoides* W. & A.

ex CLARKE in HOOK. f. Fl. Br. Ind. 2 (1879) 776; MERR. Fl. Man. (1912) 199; Sp. Blanc. (1918) 140; EN. Philip. 2 (1923) 135.

Prostrate or ascending pluricauline annual, often with a long, strongish taproot. Entire plant when young greyish green, at an advanced age often reddish brown. Stems spreading in all directions, much branched, 15–90 cm long, terete, with thickened nodes, especially in the higher part clothed with white, stellate hairs. Stipules linear, acute. Radical *leaves* rosulate, fugacious; higher leaves opposite or spuriously 3-nate, broadly oval or oval-obovate from a cuneate base, obtuse or rounded at the apex, often minutely apiculate, frequently with undulate margins, on both surfaces more or less densely (often very densely) clothed with white, stellate hairs or glabrescent above, 10–35 by 6–21 mm; petiole 4–15 mm. *Flowers* usually in fascicles of 3–8, rarely more (up to 16), mostly very shortly pedicelled or subsessile.

Pedicels 1–2 mm, stellately hairy, sometimes much longer (up to 15 mm). Tepals during anthesis (sunny morning-hours) erecto-patent, before and after anthesis erect or conniving, oblong, distinctly mucronate, 6–10 mm long, inside quite glabrous, outside more or less densely stellate-hairy, green, the in bud overlapped margins white. Stamens (in Malaysian specimens) 5–15; filaments filiform or very narrowly ligulate; anthers white. Ovary glabrous, during anthesis  $\pm$  3 mm high. Styles 5, erect or obliquely patent,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long. Capsule 5-valved. Seeds very numerous, closely packed, reniform, brown, finely granulate,  $\pm$   $\frac{2}{3}$  mm long; strophiole broad, white,  $\pm$   $\frac{1}{2}$  mm long.

Distr. S. Europe, N. & trop. Africa, S.-SE. Asia, Ceylon, and Malaysia to Australia and America, in *Malaysia*: Sumatra, Java, Lesser Sunda Islands (Bali, Sumba, Timor), Celebes (also Saleyer Island), and Philippines.

Ecol. In settled areas of the dry regions up to  $\pm$  800 m in seasonally swampy and again desiccated localities on heavy soils, in dried-up pools and ditches and on fallow rice-fields, locally often very numerous and then very conspicuous by its white or reddish brown colour, often growing intermixed with the following species.

Vern. *Kumpait, mata lèlè, sèmbung rambat*, J. Philippines: *Amargósò-bábi* (Pamp.), *lobio* (Tag.), *pápait-ti-nuáng* (Ilk.).

Note. Flowers and fruits very profusely.

**2. *Glinus oppositifolius* (LINNÉ) A.DC.** Bull. Herb. Boiss. 2, 1 (1901) 552; BACK. Onkr. Suiker. (1930) 239, Atl. t. 250; BEKN. Fl. Java, em. ed. 4 (1942) fam. 57, p. 2; MERR. & PERRY, J. Arn. Arb. 23 (1942) 3860.—*Mollugo oppositifolia* LINNÉ, Sp. Pl. (1753) 89; BURM. f. Fl. Ind. (1768) 31; SER. in DC. Prod. 1 (1824) 391; PULLE in Nova Guin. 8 (1910) 355; MERR. Fl. Man. (1912) 199; SP. Blanc. (1918) 141; EN. Philip. 2 (1923) 135.—*M. spargula* LINNÉ, Syst. ed. 10 (1759) 881; BURM. f. Fl. Ind. (1768) 31, t. 5, f. 4; SER. in DC. Prod. 1 (1824) 391.—*Pharnaceum mollugo* LINNÉ, Mant. 2 (1771) 561; ROXB. Fl. Ind. ed. CAREY 2 (1832) 102.—*Mollugo erecta* BURM. f. Fl. Ind. (1768) 32.—*Pharnaceum parviflorum* ROTH, Nov. Pl. Sp. (1821) 186.—*Mollugo parviflora* SER. in DC. Prod. 1 (1824) 391.—*Polycarpaea frankenioides* PRESL, Rel. Haenk. 2 (1830) 6; F.-VILL. Nov. App. (1880) 15.—*M. verticillata* ROXB. (non LINNÉ) Fl. Ind. ed. CAREY 1 (1832) 360.—*M. subserrata* BLANCO, Fl. Fil. (1837) 51, ed. 2 (1845) 34, ed. 3, 1 (1877) 63.—*Glinus mollugo* FENZL, Ann. Mus. Wien. 1 (1836) 359, 360; 2 (1839) 303; ZOLL. Syst. Verz. (1854) 141; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1063; RIDL. Fl. Mal. Pen. 1 (1922) 867.—*Glinus spargula* FENZL in SPRENG.

Nom. Bot. ed. 2, 1 (1840) 688; K. SCH. & LAUT. Fl. D. Sch. Geb. Süds. (1900) 308; PULLE, Nova Guin. 8 (1910) 355; KOORD. Exk. Fl. 2 (1912) 206.—**Fig. 1.**

Erect, ascending or almost prostrate, usually pluricauline, often much branched annual with a strongish taproot; stems 10–60 cm long, terete, with thickened nodes. *Leaves* for the greater part in spurious whorls of 3–5 of which usually 2 leaves larger than the others, oblong-obovate-spathulate from a tapering or slightly contracted base, with a rounded, obtuse, acute or minutely cuspidate apex, glabrous or thinly hairy, 6–40 cm by 3–15 mm; petiole 1–8 mm. *Flowers* in fascicles of 2–6, always distinctly pedicelled; pedicels thin, glabrous, 4–15 mm long when adult. Tepals during anthesis (sunny morning-hours) erecto-patent, before and after anthesis erect, oblong, obtuse, green with scarious margins or the inner almost entirely scarious, quite glabrous, 3–5 mm long. Stamens 3–4; filaments filiform. Ovary glabrous; styles 3–4, widely patent or recurved, oval-oblong, less than  $\frac{1}{2}$  mm long. Capsule oblong, 3– $3\frac{1}{2}$  mm long, 3–4-valved. Seeds closely packed, reniform, brown, finely granulate,  $\pm$   $\frac{1}{2}$  mm long.

Distr. Trop. Africa and Asia throughout *Malaysia* to N. Australia.

Ecol. In settled areas of the dry regions, from the plains up to  $\pm$  100(–275) m, in seasonally swampy or inundated and again desiccated localities, in dried-up pools and ditches and on rice-fields, either fallow or used for a second crop (in crop-rotation), locally often very numerous, frequently growing intermixed with the preceding species but less conspicuous than this and, on the whole, less common, often also on lighter soils, sometimes in sandy localities near the sea.

Uses. According to FENZL (Ann. Wien. Mus. 2, 1839, 303) this herb is considered in Hindustan as promoting digestion and salivation and, moreover, used as a medicine for bowel-complaints and syphilitic affections.

Vern. *Kailon padi* (Sumbawa). Philippines: *Amargósò-babi, margósò-damúlag* (Pamp.), *mala-gósò, sarsalida* (Tag.), *pápait* (Ilk.).

Note. Often profusely flowering and fruiting. Where *Gl. lotoides* and *Gl. oppositifolius* grow intermixed, as is often the case, an intermediate form, probably a hybrid, is not rarely found. This form has distinctly petioled leaves, agreeing in shape with those of *Gl. lotoides*, but, on the whole, smaller and less densely hairy; flowers subsessile, smaller than those of *Gl. lotoides*, 3–4 mm long; tepals acute, hairy. Like in *Gl. oppositifolius* there are 3–4 stamens; fruit 3-valved; styles agreeing in shape with those of *Gl. lotoides* but shorter.

### 3. SESUVIUM

LINNÉ, Syst. ed. 10 (1759) 1058.

Prostrate, creeping or erect succulent herbs or undershrubs. *Leaves* opposite, exstipulate, often by their sheathing bases connected in pairs, linear, lanceolate or oblong, very fleshy. *Flowers* axillary (only spuriously so?), solitary, clustered or cymose, sessile or stalked, bibracteolate, actinomorphic, ♂. Perianth



Fig. 1. *Glinus oppositifolius* (L.) DC.,  $\times \frac{1}{2}$ .



gamophyllous, deeply 5-partite; tube obconical; segments oblong, obtuse, just below the apex often dorsally apiculate, coloured inside. *Stamens* either 5, alternating with the perianth-segments, or  $\infty$ , inserted in the mouth of the perianth-tube; filaments filiform or very narrowly linear, free or connate at the base; anthers 2-celled. Ovary superior, 3–5-celled; cells  $\infty$ -ovuled. Styles 3–5, filiform, stigmatose on the inner side. *Capsule* oblong, thin-walled, 3–5-celled, operculate. Seeds several in each cell, globose-reniform; testa smooth; embryo annular.

Distr. Species  $\pm$  8 in the tropics and subtropics of both hemispheres, often littoral, in *Malaysia* only the cosmopolitan *S. portulacastrum* L.

1. *Sesuvium portulacastrum* (LINNÉ) LINNÉ, Syst. ed. 10 (1759) 1058; BURM. f. Fl. Ind. (1768) 117; ROXB. Fl. Ind. ed. CAREY, 2 (1832) 509; BLANCO, Fl. Fil. (1837) 426, ed. 2 (1845) 297, ed. 3, 2 (1878) 187; KOORD. Minah. (1898) 487; K. SCH. & LAUT. Fl. D. Sch. Geb. Süds. (1901) 309; MERR. Govt. Lab. Publ. 27 (1905) 50; VALET. Bull. Dép. Agr. Néerl. 10 (1907) 10; PULLE, Nova Guin. 8 (1910) 355; KOORD. Exk. Fl. 2 (1912) 206; MERR. Fl. Man. (1912) 198; Interpr. Herb. Amb. (1917) 217; BACK. Trop. Natuur 8 (1919) 7, f. 14; RIDL. Fl. Mal. Pen. 1 (1922) 866; MERR. En. Philip. 2 (1923) 135; HOCHR. Candollea 2 (1925) 356; HEYNE, Nutt. Pl. (1927) 611; BACK. Onkr. Suiker. (1930) 240, t. 251; OCHSE & BAKH. v. D. BR. Veg. (1931) 5, f. 4; BURK. Dict. (1935) 1998; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 58, p. 2; HEND. Mal. Wild Fl. 1 (1949) 171, f. 164; STEEN. Fl. Sch. Indon. (1949) 175.—*Crithmus indicus ruber* & *albus* RUMPH. Herb. Amb. 6 (1750) 165, t. 72, f. 1.—*Portulaca portulacastrum* LINNÉ, Sp. Pl. (1753) 446.—*Sesuvium repens* WILLD. En. Hort. Ber. 1 (1809) 521; DC. Prod. 3 (1828) 453; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1060.—*Trianthema polyandrum* BL. Bijdr. (1826) 1137; DECNE, Nouv. Ann. Mus. 3 (1834) 448; SPAN. Linnæa 15 (1841) 207.—*Pyxipoma polyandrum* FENZL, Ann. Mus. Wien 2 (1839) 293; ZOLL. Syst. Verz. (1854) 140; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1060.—*Sesuvium polyandrum* FENZL ex BRITT. in FORB. Wand. (1885) 506.—Fig. 2.

Perennial, prostrate or creeping herb, with a strong taproot, often much branched and densely caespitose, quite glabrous. Stems rooting from the nodes, terete, rather thick, solid, succulent, green or very often red, 20–80 cm long. *Leaves* mostly lanceolate, linear-lanceolate or linear, less often oblong, broadest above the middle, very succulent, flat above, convex underneath, green or, at the base, red, finely pale-punctate, 25–70 by 6–15 mm. Petioles 7–15 mm long, dilated at the base into a scarious semi-amplexicaul sheath. *Flowers* solitary in the leaf-axils. Pedicels thickened upwards,  $1/2$ – $1\frac{1}{2}$  cm long, rarely longer. Perianth 8–10 mm long, 5-cleft to far below the middle. Segments with a dorsal, subapical, erect, subulate, obtuse, fleshy,  $\pm$   $1\frac{1}{2}$  mm long apiculus; the parts exposed in bud fleshy, green outside, overlapped margins membranous pink, inside of perianth pink. *Stamens*  $\infty$ , filaments free, pink or pinkish violet, shorter than the perianth-lobes, anthers darker-coloured. Ovary glabrous, 3- or sometimes 4-celled. Styles as many as cells, white. *Capsule* included by the perianth,

oblong, 9–11 mm long. Seeds long-funicled, shining black.

Distr. Cosmopolitan in the tropics, throughout *Malaysia*, but not yet reported for Borneo. In Celebes thus far only collected in the extreme NE. part, in Sumatra only in the NE. part.

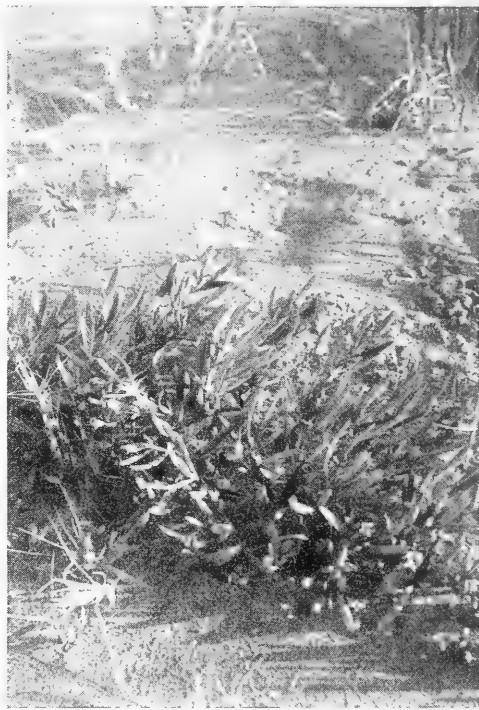


Fig. 2. *Sesuvium portulacastrum* (L.) L. on the sandy beach of W. Bali (DE VOOGD).

Ecol. Saline, clayey or sandy, humid or muddy localities near the sea and along tidal creeks between 0 en 1 m above sealevel, often in dense patches; frequently conspicuous by bright red stems.

Uses. Furnishes an inferior vegetable, edible only after having been repeatedly cooked (in order to remove the salt taste).

Vern. Many local names of which *gèlang*, *gèlang pasir*, *saruni air*, M, and *krokot*, J, are the

commonest. Philippines: *Bilang-bilang*, *dampalit* (Bis.), *tarumpalit* (Bis.), *karampalit* (Pamp.).

Note. The cooked plant smells and tastes of purslane. The late Dr P. J. EYMA made a note on the interpretation of the original Linnean descriptions in *Species Plantarum* (1753) of *Trianthema*

*portulacastrum* and *Portulaca portulacastrum* (now *Sesuvium portulacastrum*), the described habit of which coincides with the recent conception of these species, but the floral description of which seems to be reversed; LINNÉ seems to have corrected this himself in his later editions.

4. TRIANTHEMA

LINNÉ, Sp.Pl. (1753) 223; Gen. Pl. ed. 5 (1754) no 278.

Procumbent, diffuse, glabrous, papillose or hairy herbs, rarely undershrubs. *Leaves* opposite, obovate, ovate or oblong-linear, entire, those of one pair often very unequal; petioles dilated and sheathing at the base, often pairwise connate. Stipules minute or absent. *Flowers* axillary, solitary, glomerate or fascicled, sessile or stalked. Perianth gamophyllous, tube in the Malaysian species short. Segments 5, small or rather large, beneath the apex with a dorsal mucro, coloured inside. Stamens 5-∞, alternating with the perianth segments, solitary, paired or in groups. Filaments filiform; anthers short. Ovary superior, with a truncate or impressed apex, 1-2-celled; placentas basal, usually adnate to the septum; cells 1- or few-ovuled. Styles 1-2, longitudinally stigmatose. *Capsule* terete or turbinate, with an obtuse, truncate or impressed apex, rarely beaked, 1-2-celled, operculate; operculum thick-walled, containing 0-2 seeds, indehiscent; basal part of fruit thin-walled, 2-9-seeded. Seeds long-funicled, globose-reniform; testa ribbed or granulate; embryo annulate.

Distr. Species ± 15, widely distributed in the tropics and subtropics of both hemispheres, especially in Australia.

KEY TO THE SPECIES

- 1. Style 1.
- 2. Perianth-tube free from the petioles. Stamens 5. Flowers all or for the greater part clustered, ± 3 mm long. Young leaves distinctly papillate . . . . . 1. **Tr. triquetra**
- 2. Perianth-tube throughout its length adnate to the basal part of the petioles. Stamens 10-25. Flowers solitary, 4-5 mm long. Leaves not distinctly papillate . . . . . 2. **Tr. portulacastrum**
- 1. Styles 2, free. Flowers clustered. Perianth free from the petioles. Stamens 10-15 . . . . . 3. **Tr. decandra**

**1. *Trianthema triquetra* ROTTL. ex WILLD.** Neue Schr. Naturfr. Berlin 4 (1803) 181; DC. Prod. 3 (1828) 352; TRIMEN, Fl. Ceyl. 2 (1894) 269; COOKE, Fl. Bomb. 1 (1903) 554.—*Tr. crystallina* (AUCT. div. non VAHL) ROXB. Fl. Ind. ed. CAREY 2 (1832) 444; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1879) 660; KOORD. Exk. Fl. 2 (1912) 207; BACK. Onkr. Suiker. (1930) 241, t. 252; Bekn. Fl. Java, em. ed. 4 (1942) fam. 58, p. 2.—*Tr. sedifolia* VISIANI, Pl. Aeg. ac Nub. (1836) 19, t. 3, f. 1; ZOLL. Syst. Verz. (1854) 140; MQ. Fl. Ind. Bat. 1, 1 (1858) 1059.—*Tr. glaucifolia* F.v.M. Fragm. 1 (1859) 172.

Annual or perennial, often pluricauline, frequently with a very strong taproot, usually much branched from the very base. Branches prostrate, 20-60 cm long, terete, much tinged with purple, thin, narrowly fistular. Young parts studded with glassy papillae. *Leaves* linear or linear-lanceolate, greyish green, glabrous, fleshy-succulent, with a well-developed central aquiferous tissue, 20-30 by 2½-4 mm; those of one pair not very much differing in size. Petiole much shorter than the lamina, dilated at the base into a semi-amplexicaul sheath, usually bearing on the top, on either side, a minute dentiform stipule; sheaths of one leaf pair free

from each other. *Flowers* in clusters of 2-6, or rarely, and only a few, solitary, often crowded on short lateral branchlets, sessile, free from the petiolar sheaths. Perianth ± 3 mm long, throughout its length longitudinally ribbed, 5-cleft ± halfway down; tube obconical. Segments obliquely erect or at last spreading-recurved, ovate-triangular, rather acute or rather obtuse, with a dorsal subapical minute obtuse mucro, inside sordidly white with green markings. Stamens 5, much shorter than the tepals; anthers purplish. Ovary with an obconical base, its apex rounded-truncate, impressed in the centre. Style 1, excentric, very short. *Capsule* enclosed by the calyx-tube, its operculum thick; its apex seedless inside but with its inverted-cupshaped basal part narrowly surrounding a single seed which it carries away in falling off; basal part of the fruit cup-shaped, thin-walled, likewise 1-seeded; both seeds in unopened fruits appressed against each other. Seeds subhorizontal orbicular, concavo-convex, brownish black, faintly reticulate-ribbed and especially around the margin studded with short white papillae which swell up when wetted, 1-1¼ mm diam.

Distr. Tropical Africa and Asia to Victoria, in

*Malaysia*: NE. Java & Lesser Sunda Islands (Bali).

Ecol. Periodically very dry regions, in clayey or rocky, often saltish localities, from the sea-shore up to  $\pm 10$  m altitude, often gregarious, especially on the dikelets between the fish-ponds along the sea; less often on fallow rice-fields.

Vern. *Gèlang*, J, *krakat*, Md.

Note. Often confused with *Tr. crystallina* VAHL from Nubia and Arabia which differs by oval or lanceolate, smaller ( $1\frac{1}{2}$ –2 cm long) often unequal-sided leaves.

2. *Trianthema portulacastrum* LINNÉ, Sp. Pl. (1753) 223; PULLE, Nova Guinea 8 (1910) 355; MERR. Fl. Manila (1912) 198; En. Philip. 2 (1923) 136; BACK. Onkr. Suiker. (1930) 242, t. 253; BEKN. Fl. Java, em. ed. 4 (1942) fam. 58, p. 2; STEEN. Fl. Sch. Indon. (1949) 174.—*Tr. monogyna* LINNÉ, Mant. 1 (1767) 69; DC. Prod. 3 (1828) 352; ZOLL. Syst. Verz. (1854) 140; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1059; KOORD. Exk. Fl. 2 (1912) 207.—*Tr. obcordata* ROXB. Fl. Ind. ed. CAREY 2 (1832) 445; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1059.—*Portulaca toston* BLANCO, Fl. Fil. (1837) 408.—*P. axilliflora* (non PERS.) BLANCO, Fl. Fil. ed. 2 (1845) 285, ed. 3, 2 (1878) t. 165.

Prostrate or ascending often much branched annual with a firm taproot. Stems subterete or slightly angular, thickened and flattened on the nodes, glabrous or finely pubescent, 15–50 cm long. Branches in the axils of the smaller leaves of the pairs, alternating. Leaves thin-fleshy, quite entire, purple-margined, barring the petiole quite glabrous; those of one pair very unequal in size; larger ones oval-obovate-obcordate from a cuneate base, obtuse, rounded or retuse,  $1\frac{1}{2}$ –5 by 1–4 $\frac{1}{2}$  cm; smaller ones either of the same shape or more oblong, 8–30 by 4–25 mm. Petioles 4–30 mm, on the top of the flattened upper surface with a few short, thick hairs; their sheathing membranous bases connate pairwise below into a funnel-shaped pouch which bears on its apex on the right and the left a small stipule. Stipules acuminate from a pale base, with an acute red apex, on the midrib thinly beset with short thick hairs, 2–2 $\frac{1}{2}$  mm long. Flowers sessile, solitary in the leaf axils; their lower part hidden by the petiolar pouch. Perianth totalling 4–5 mm, usually pale pink, rarely white; tube adnate throughout its length to the base of 1 or 2 petioles, segments rather obtuse with a longish dorsal, subapical micro. Stamens 10–25; filaments white, glabrous, 2–3 mm; anthers pale pink. Ovary  $\pm$  turbinate, truncate, glabrous, incompletely divided into 2 superposed cells by a transverse inner ring; both cells ovate. Style 1,  $\pm 3$  mm long, unilaterally stigmatose throughout its length. Capsule partly exerted, with a truncate bilobed apex; operculum fleshy, containing 1–2 seeds, indehiscent; basal part of the fruit thin-walled, 2–9-seeded. Seeds reniform, dull black, with faint wavy ribs,  $1\frac{3}{4}$ –2 $\frac{1}{2}$  mm broad.

Distr. Pantropic, in *Malaysia*: Malay Peninsula, Philippines, Java, Madura, Lesser Sunda Islands (Sumbawa, Flores, Timor), Moluccas (Ternate), S. New Guinea.

Ecol. In Java throughout the drier parts of the island from quite near the sea up to  $\pm 200$  m, in sunny, periodically dry localities, either saline or not, in cultivated or fallow fields, on roadsides, preferably on clay near the sea, locally often numerous.

Use. VAN STEENIS (*l.c.* p. 175) states that the young leaves are sometimes eaten as a vegetable.

Vern. *Krokot*, *tèlèkan*, J, *kradjep*, Md. Philip-pines: *Ayam*, *ulisiiman* (Bis.), *toston* (Tag.).

Note. For the interpretation of the Linnean description see the note under *Sesuvium portulacastrum*.

3. *Trianthema decandra* LINNÉ, Mant. 1 (1767) 70; ROXB. Fl. Ind. ed. CAREY 2 (1832) 444; DC. Prod. 3 (1828) 352; KOORD. Exk. Fl. 2 (1912) 207.—*Tr. pentandra* (auct. non LINNÉ) DECNE, Nouv. Ann. Mus. 3 (1834) 448; SPAN. Linnaea 15 (1841) 120; ZOLL. Syst. Verz. (1854) 140; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1158.—*Zaleya decandra* BURM. f. Fl. Ind. (1768) 110, t. 31, f. 3.

Herb with a strong taproot. Stems prostrate, more or less (usually not very much) branched, angular and striate, sometimes up to 2 m long but mostly much shorter (50–75 cm); young parts rather densely beset with small white papillae, tardily glabrescent. Leaves oval-oblong-obovate-subspatululate from an acute base, acute, obtuse or rounded at the apex, rather densely studded (especially on the midrib and along the margins, moreover on the petiole) with small, white, at last shrivelling white papillae,  $\pm$  fleshy,  $1\frac{1}{2}$ –5 cm by 5–18 mm, those of one pair  $\pm$  unequal. Petioles rather long, 3–20 mm, scarious-margined; their much dilated sheathing bases not connate into a pouch and not concealing the flowers. Flowers few to rather many in dense, sessile or subsessile clusters, shortly pedicelled or subsessile. Bracteoles oblong-lanceolate, thinly membranous. Perianth  $\pm 4$  mm long, deeply 5-partite; tube free from the petioles, shortly obconical. Segments much longer, oval, with broad membranous margins and a thicker, longitudinally nerved central field, ending near the top of the segment in a longish dorsal micro, glabrous, green outside, pink within. Stamens 10–15, free, shorter than perianth. Ovary cylindric-obpyramidal, crowned by 2 recurved shortish styles. Capsule  $\pm 4$  mm long, with a cylindric, faintly 2-lobed, solid beak; beak separating from the basal part of the fruit by a circular cleft; beak containing 2 seeds; lower part of the fruit with 2 superposed seeds. Seeds orbicular-reniform, with slightly prominent ribs on the back and faint tubercles on the sides, dull-black,  $\pm 1\frac{1}{2}$  mm diam.

Distr. Ceylon, Hindustan, Australia, in *Malaysia*: Lesser Sunda Islands (Sumbawa and Timor).

Ecol. Grassy localities in seasonally dry regions, only rarely collected.

Vern. *Ngépa tanah* (Sumbawa).

Note. According to TRIMEN *l.c.* the fully expanded flowers are very pretty.

## 5. TETRAGONIA

LINNÉ, Sp.Pl. (1753) 480; Gen. Pl. ed. 5 (1754) no 551.

Erect, ascending, prostrate or climbing herbs or undershrubs, studded all over with minute, shining, white papillae. *Leaves* spirally arranged, flat or slightly undulate, fleshy, exstipulate. *Flowers* axillary, solitary or fascicled, sessile or stalked, greenish or yellowish. Perianth-tube produced above the ovary; segments 3–5, short, often unequal. Stamens 1 or more in the mouth of the perianth tube, alternating with the segments, solitary or in groups. Ovary semi-inferior, 2–9-celled, with 1 pendulous ovule in each cell. Styles equal in number to the cells, linear, stigmatose along the inner side. *Fruit* turbinate or obovoid with a hard, almost woody endocarp; the herbaceous or almost fleshy epicarp tipped with the enlarged calyx-limb, with apical tubercles or hornlets which not rarely develop into a flower, a branchlet or a spine, indehiscent.

Distr. Species 50–60, mainly in the S. hemisphere, especially in S. Africa and Chile, a few in Australia, Tasmania, New Zealand, Polynesia, and Japan, in *Malaysia* only a cultivated species.

1. *Tetragonia tetragonioides* (PALLAS) O.K. Rev. Gen. (1891) 264.—*Demidovia tetragonioides* PALLAS, En. Pl. Demidof (1781) 150, t. 1.—*Tetragonia expansa* MURR. Comm. Goett. 6 (1783) 13; CURT. Bot. Mag. (1823) t. 2362; DC. Prod. 3 (1828) 452; HEYNE, Nutt. Pl. (1927) 611; OCHSE & BAKH. v. D. BR. Veg. (1931) 6, f. 5; BURK. Dict. 2 (1935) 2143; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 58, p. 3.—*T. cornuta* GAERTN. Fruct. 2 (1791) 483.—*T. inermis* F.v.M. Linnaea 25 (1852) 384.

Fleshy, widely branched (often from the very base), annual. Stems erect when young, afterwards trailing-ascending, thick, terete or slightly angular, light green, 10–100 cm long. *Leaves* ovate-rhomboid-triangular from a  $\pm$  decurrent, cuneate or contracted base, obtusely acuminate or obtuse, flat or slightly undulate, darkgreen above, light green or pale green beneath, dull on both sides,  $1\frac{1}{2}$ –11 by 1–7 $\frac{1}{2}$  cm; petiole thick,  $\frac{1}{2}$ –2 $\frac{1}{2}$  cm. *Flowers* solitary or 2–3 together. Pedicels  $\pm$  2 mm. Perianth-tube turbinate, during anthesis  $1\frac{1}{2}$ –2 mm high, under each segment with a short hornlet, which enlarges after anthesis and sometimes de-

velops into a flower or a branchlet. Segments 3–5, often 4, during anthesis patent with recurved margins, afterwards erect or connivent, green externally, yellowish green or pale green inside, 2–3 mm long, unequal; 1–2 of them broadly ovate or semi-orbicular, obtuse or rounded, the 2 lateral ones narrower, ovate-triangular, obtuse. Stamens 4–10; filaments yellow, 1–1 $\frac{1}{2}$  mm. *Fruit* turbinate, obtusangular, subtruncate, 2–5-horned,  $\frac{1}{4}$ –1 $\frac{1}{4}$  cm long, 4–10-seeded.

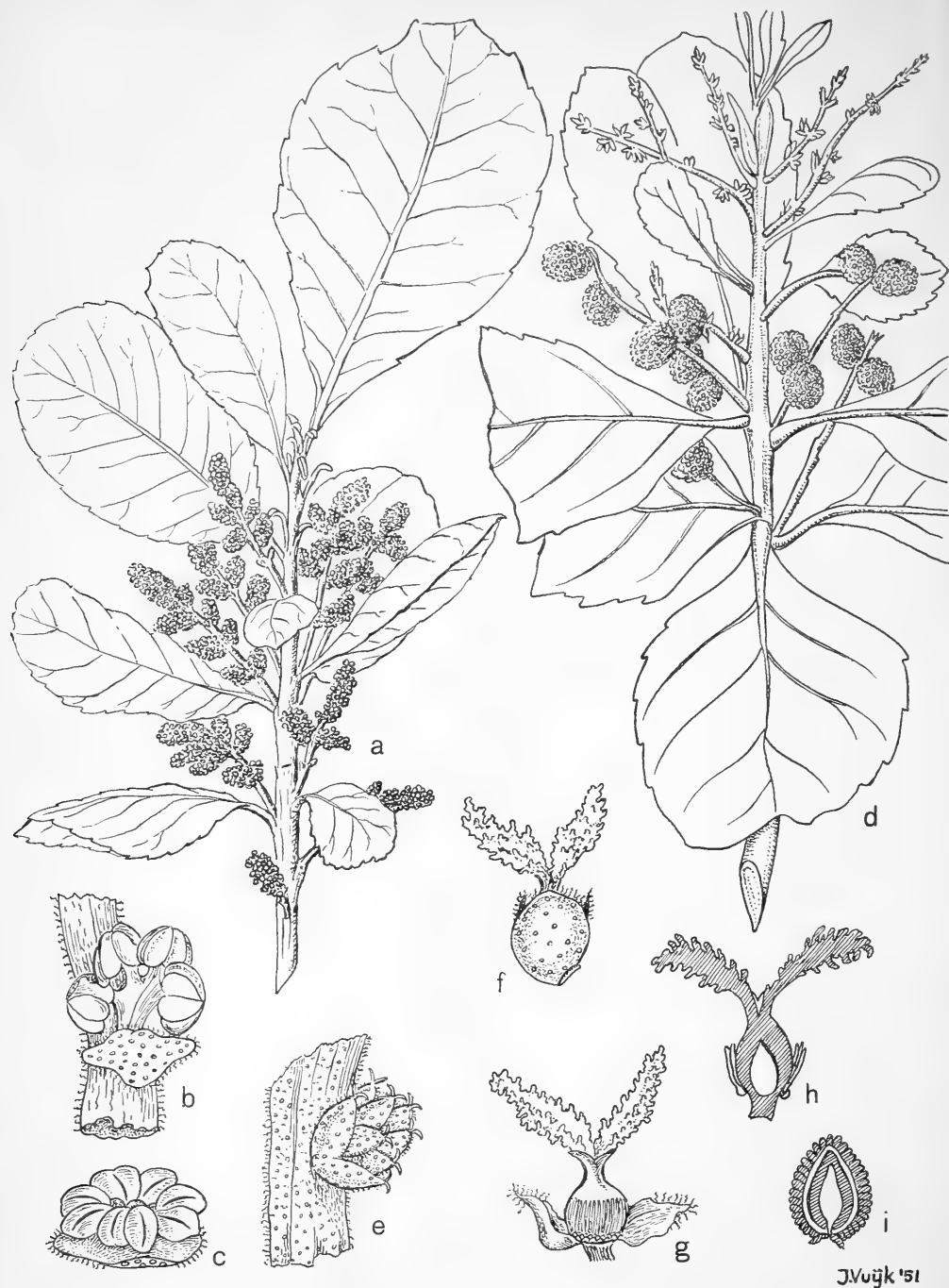
Distr. Wild in the coastal regions of Australia, Tasmania, New Zealand, Japan, and the Pacific Islands.

Uses. In *Malaysia*, especially in the mountainous regions, cultivated as a potherb, mostly 1000–1700 m, e.g. in W. Java and N. Sumatra.

Vern. *Nieuw-Zeelandse spinazie*, D, *New Zealand spinach*, E, *kabak*, M.

## Excluded

*Adenogramma oppositifolia* HASSK. = *Alternanthera sessilis* (L.) R.Br. (*Amaranthaceae*), cf. p. 92, bottom of first column.



J.V. '51

Fig. 1. *Myrica javanica* Bl. a-c ♂, d-i ♀.—a. Flowering twig, b-c. flower analysis, d. flowering twig, e-g. flower analysis, h-i. longitudinal section of flower and fruit. (a & d nat. size, others enlarged.) After BLUME.

## MYRICACEAE (C. A. Backer, Heemstede)

### MYRICA

LINNÉ, Sp.Pl. (1753) 1024; Gen. Pl. ed. 5 (1754) no 981.—*Morella* LOUR. Fl. Coch. (1790) 548.

Trees or erect shrubs, often dotted with yellow glands and strongly aromatic. *Leaves* spirally arranged, exstipulate, or stipulate in young plants only, shortly petioled, simple, entire, serrate-dentate or more or less deeply pinnatisect, penninerved. *Flowers* in axillary, solitary or spiked or racemed catkins, (♂) (♀) or (♂♀); when the inflorescence is (♂♀), then the ♂ flowers below the ♀; each flower subtended by a bract. Sepals and petals absent, or the ♀ with 2 or more minute sepaloid bracteoles. ♂: *Stamens* 2–20, usually 2–4; filaments free or more or less connate into a column; anthers erect, 2-celled; cells opening by longitudinal slits. Rudimentary ovary, as a rule, absent. ♀: no staminodes. Ovary sessile, 1-celled. Style deeply bifid; branches short or longish, stigmatose on the inner side. Ovule 1, basal, erect, orthotropous. *Drupe* ovoid, ellipsoid or globose, tuberculate; endocarp hard. Seed erect, not comose; testa membranous; endosperm none; embryo straight; cotyledons plano-convex; radicle short.

Distr. Species according to CHEVALIER ca 50, but this number may be greatly reduced. By some authors the genus has been split into 3 genera, but I am inclined to accept only one.

N. and S. America, Canaries, tropical and S. Africa, Europe, N.-, tropical and East Asia, *Malaysia*, and Hawaii, not in Australia. In *Malaysia* 2 polymorphous species. Moreover, some forms, represented by inadequate materials from East *Malaysia*, may in the future prove worthy of specific rank. They will be dealt with at the end of this paper.

Ecol. Heliophilous, often gregarious, sometimes locally vulcanophile in the mountainous regions.

Uses. See under *M. javanica* BL.

Wood anat. MOLL & JANSSONIUS, Mikr. Holzes 6 (1936) 333. METCALFE & CHALK, Anat. Dic. 2 (1950) 1292. DEN BERGER, Determinatietabel Houtsoorten van Malesië (1949) 32 (hand lens).

#### KEY TO THE SPECIES (see also p. 279)

1. Leaves of adult specimens shallowly or coarsely but always distinctly serrate or crenate-serrate, 2–7½ cm wide, entirely hairless. Leaf-base acute or obtuse. Young branchlets quite glabrous. Stigmas narrowly ovate-triangular, ½–1¼ mm long . . . . . 1. *M. javanica*
1. Leaves of adult specimens quite entire, 1–4½ cm wide, usually more or less densely hairy. Leaf-base acute, rounded or cordate. Young branchlets usually hairy. Stigmas linear-filiform, ± 2½ mm long. . . . . 2. *M. esculenta*

1. *Myrica javanica* BL. Bijdr. (1825) 517; Fl. Jav. (1828) 7, t. 1; ZOLL. Syst. Verz. (1854) 86; MIQ. Fl. Ind. Bat. 1, 1 (1858) 871; Sum. (1860) 141; DC. Prod. 16, 2 (1868) 152; STAPF, Trans. Linn. Soc. Bot. 4 (1894) 231 incl. f. *alpina* STAPF; KOORD. Minah. (1898) 614; CHEVALIER, Mém. Soc. Nation. Sc. Nat. Cherb. 32 (1901) 213; K. & V. Bijdr. 9 (1903) 101; MERR. Philip. J. Sc. 2 (1907) Bot. 270; KOORD. Versl. Kon. Akad. Wet. A'dam 16 (1908) 646–652; Exk. Fl. 2 (1912) 48; Atlas Baumart. Java 2 (1914) t. 374; MERR. En. Born. (1921) 210; En. Philip. 2 (1923) 23; KOORD. Fl. Tjib. 2 (1923) 8; MARKGRAF, Bot. Jahrb. 59 (1925) 540; HEYNE, Nutt. Pl. (1927) 534; ANON. Trop. Natuur 17 (1928) 168; DOCT. v. LEEUWEN, Bull. J.B.B. III, 11 (1930) 49 et passim; Verh. Kon. Akad. Wet. A'dam 31 (1933) 155; t. 23; FREY-WYSSL. Trop. Natuur 22 (1933) 7, f. 7; v. MALM in FEDDE, Repert. 34 (1934) 270; STEEN. Bull. J.B.B. III, 13 (1936) 229; *ibid.* 17 (1948) 389; BACK. Bekn. Fl. Java, em. ed. 6 (1948) fam. 124, p. 1.—*M. macrophylla* MIRBEL, Mém.

Mus. Paris 14 (1827) 472, t. 72.—*M. vidaliana* ROLFE, J. Linn. Soc. Bot. 21 (1884) 316; VIDAL, Rev. Pl. Vasc. Filip. (1886) 259; CHEV. Mém. Soc. Nat. Sc. Nat. Cherb. 32 (1901) 213.—Fig. 1.

Much branched tree or erect shrub, 2–10 m high, exceptionally up to 20 m; trunk crooked; no buttresses. Crown rather dense. Branchlets greyish black, hairless, densely beset with sessile yellow glands when young. *Leaves* elliptic, obovate or oblong-obovate from an acute or obtuse base, at the apex rounded, very obtuse, or sometimes slightly emarginate, shallowly to rather coarsely serrate or crenate-serrate, firmly coriaceous, hairless, when very young on both sides rather densely beset with sessile yellow glands, afterwards, especially on the upper surface, soon losing the glands which leave shallow pits, 4–14 cm by 2–7½ cm; midrib strongly prominent beneath; lateral nerves on either side of the midrib 5–12, erecto-patent, often forked, frequently ending in a short, thick marginal toothlet, faintly prominent to slightly depressed above,

rather prominent beneath; petiole firm,  $1/2$ – $1\frac{1}{2}$  cm. *Flowers* ( $\delta$ ) ( $\varnothing$ ), very exceptionally a few  $\varnothing$  flowers among the  $\delta$  ones.  $\delta$ : *Inflorescences* solitary in the leaf-axils, erect to widely patent, 4–18 cm long (peduncle included); rachis clothed with numerous yellow glands and many more or less patent short hairs, in the higher part bearing several at last widely patent catkins, rarely bearing part of the catkins on short secondary branchlets; catkins solitary in the axil of an ovate, acute, 2–3 mm long bract, sessile,  $3/4$ –3 cm long. Single flowers in the axil of a bract; floral bracts quite free from the staminal column, ovate, shortly acuminate, strongly vaulted, shortly hairy along the margin and on the back and studded with yellow glands, 2– $2\frac{1}{2}$  mm long, persistent. Stamens usually 4, very rarely 3 (see note); filaments for the greater part of their length connate into a shorter or longer column; staminal column thick, thinly patently hairy and studded with yellow glands. Anthers shortly stalked, vertical, contiguous, thick, with many sessile glands, bivalved; no rudimentary ovary.  $\varnothing$ : *Inflorescences* solitary in the leaf-axils, erect or erecto-patent, not or sparingly branched, rather lax, 3–7 cm long; rachis clothed with very many sessile yellow glands and a number of patent short hairs; catkins solitary in the axil of an ovate-triangular acute,  $1\frac{1}{2}$ –2 mm long bract, 5–10 mm long very dense. Flowers 5 or more, imbricate, each in the axil of a small ovate, acute hairy bract. Bracteoles at the base of the flower 2, appressed against the ovary, ovate, shortly acuminate, ciliate, hairy and glandular on the back,  $3/4$ –1 mm long. Ovary ellipsoid-ovoid, very densely studded with short rounded tubercles. Stigmas 2, sessile, spreading narrowly, ovate-triangular, acute, flat, red,  $1/2$ – $1\frac{1}{4}$  mm long. Berries 1 or rarely 2 per catkin, broadly ellipsoid, with many yellow glands, otherwise glabrous, black with bluish violet juice, rather acid not palatable.

*Distr. Malaysia*: Central Sumatra, Java (Mt Salak to Mt Jang), Lesser Sunda Islands (Bali, Lombok), N. and Central Borneo, Philippines, N. and S. Celebes, New Guinea, 900–3300 m.

*Ecol.* Prefers open, sunny, stony localities, often near active craters, on ridges, and lavastreams, there often forming a pioneer-vegetation and becoming gregarious, elsewhere mixed with other shrubs and small trees forming a rather dense jungle in which it may predominate. *Fl. fr.* Jan.–Dec.

*Vern.* *Mangkoan*, *pitjisan*, *sang*, *wuru kèrèk*, *J*, *tètèkèan*, *tèkè*, *S*, Philippines: *Hindang* (C.Bis.).

*Uses.* The wood furnishes a highly valued fuel. An excellent charcoal is made of it. Ripe berries are edible. Cultivated for reforestation, also as a road-side or a court-yard tree.

*Note.* Fruits sought after by several species of birds, *i.a.* pigeons, which spread the seeds. In the crop of a single pigeon 144 viable seeds were found. On Mt Kinabalu epiphytic specimens were said to have been collected on big trees by M. S. CLEMENS in Aug. 1933.

Not too young juvenile forms possess obovate, rather deeply, narrowly and very acutely serrate

leaves of  $2\frac{1}{2}$ –6 cm by  $1\frac{1}{2}$ –3 cm; leaf-teeth with a thickened apex; stipules narrowly ovate-lanceolate, acute, 2–4 mm long, caducous.

*M. vidaliana* ROLFE *l.c.* is a Philippine form of this species with small ( $1\frac{1}{2}$ –6 cm by  $3/4$ –2 cm), shallowly serrate leaves. Male inflorescences small; stamens 3, rarely 2. This form passes into typical *M. javanica* by intergrades.

2. *Myrica esculenta* BUCH.–HAM in D. DON, *Prod. Fl. Nep.* (1825) 56; CHEV. *Mém. Soc. Nation. Sc. Nat. Cherb.* 32 (1901) 204 *incl. var. farquhariana* (WALL.) CHEV., *var. lobbii* (T. & B.) CHEV. and *var. sapida* (WALL.) CHEV.; MERR. *Philip. J. Sc.* 2 (1907) Bot. 269; (*aesculenta*) GAMBLE, *J. As. Soc. Beng.* 75 (1915) 404 *incl. var. auriculata* GAMBLE; MERR. *En. Born.* (1921) 210; *En. Philip.* 2 (1923) 23; *Philip. J. Sc.* 29 (1926) 362, *sphalm. farquhariana*; STEEN. *Bull. J.B.B. III*, 13 (1936) 229; BACK. *Bekn. Fl. Java em. ed.* 6 (1948) fam. 124, p. 1.—*M. farquhariana* WALL. *Tent. Fl. Nep.* (1826) 61; DC. *Prod.* 16, 2 (1868) 152; RIDL. *Fl. Mal. Pen.* 3 (1924) 370, f. 157; BURK. *Dict.* 2 (1935) 1521; CORNER, *Ways. Tr.* (1940) 417, f. 158.—*M. sapida* WALL. *Tent. Fl. Nep.* (1826) 59, t. 45.—*M. rubra mult. auct. non* SIEB. & ZUCC. *Abh. Akad. München* 4<sup>3</sup> (1846) 230.—*M. longifolia* T. & B. [*Cat. ined. Hort. Bog.* (1854) 63, 241] *ex* MIQ. *Fl. Ind. Bat.* 1, 1 (1858) 872; DC. *Prod.* 16, 2 (1868) 152; K. & V. *Bijdr.* 9 (1903) 103; KOORD. *Versl. Kon. Akad. Wet. A'dam* 16 (1908) 652; *Exk. Fl.* 2 (1912) 49; v. MALM in FEDDE, *Rep.* 34 (1934) 270; STEEN. *Bull. J.B.B. III*, 13 (1936) 229.—*M. lobbii* T. & B. *ex* MIQ. *Fl. Ind. Bat.* 1, 1 (1858) 872; DC. *Prod.* 16, 2 (1868) 684 (*addenda*); CHEVALIER, *l.c.* p. 204.—*M. nagi* (*non* THUNB.) RIDL. *Agr. Bull. Str. & F.M.S.* 1 (1901) 258; *in* MERR. *En. Philip.* 2 (1923) 23.—*M. auriculata* RIDL. *Fl. Mal. Pen.* 3 (1924) 371.

Small tree, 3–15 m high; trunk crooked, irregularly branched; bark grey. Branchlets usually moderately densely clothed with patent, longish, less often short, thin hairs, mixed with scattered sessile yellow glands, sometimes hairless and more or less densely glandular only. *Leaves* lanceolate, lanceolate-obovate or oblong-obovate, from a gradually narrowed, acute, narrowly rounded or (young trees) narrowly cordate base, acuminate or not, with an acute or rather acute, less often obtuse apex, on adult trees entire and firmly coriaceous, on the upper surface with or without minute yellow glands, beneath bearing many caducous minute glands which leave a shallow pit on falling off, ciliate or not, either thinly pubescent on both surfaces (especially on larger nerves), or only beneath, or quite glabrous, shining darkgreen above, on adult trees  $2\frac{1}{2}$ –15 cm by  $1$ – $1\frac{1}{2}$  cm (for very young trees see beneath); midrib strongly prominent beneath; lateral nerves on either side of midrib 5–15, obliquely erect or ascending from a patent base, inarching near the margin or not, prominent beneath. Petiole firm, pubescent or glabrous, 2–10 mm. *Flowers* ( $\delta$ ) ( $\varnothing$ ).  $\delta$ : *inflorescences* solitary in the leaf-axils, erecto-patent to widely patent, 3–8 cm long (short peduncle included). Rachis thin, usually rather densely clothed with more or less patent,



longish or short white hairs, between the hairs with scattered yellow glands, sometimes hairless and glandular only, bearing several rather remote, at last widely patent catkins; catkins singly in the axil of a triangular,  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm long, hairy bract, sessile or shortly stalked,  $\frac{1}{2}$ – $1\frac{1}{2}$  cm long, dense or rather lax; their rachis patently hairy. Floral bracts ovate-triangular, patently hairy on the back,  $\pm 1\frac{1}{4}$  mm long. Stamens 4, rarely 3, very rarely 2; filaments connate at the base into a column  $\frac{1}{4}$ – $\frac{1}{2}$  mm long; anthers distinctly or hardly stalked, vertical, contiguous, thick, red, beset with numerous very short, comparatively thick hairs,  $\pm \frac{3}{4}$  mm long; no rudimentary ovary. ♀: *Inflorescences* solitary in the leaf-axils, erect or more or less widely patent,  $1\frac{1}{2}$ –5 cm long, simple. Rachis thin, mostly clothed with patent longish or short hairs, mixed with scattered yellow glands, sometimes hairless. Catkins in the lower part remote, higher up often crowded, placed singly in the axil of an ovate-triangular, hairy,  $1\frac{1}{4}$ –3 mm long bract, sessile,  $1\frac{1}{2}$ –2 mm long, consisting of 10 or fewer densely crowded flowers. Floral bracts ovate-triangular, acute, hairy and glandular,  $\pm 1\frac{1}{2}$  mm long. Bracteoles very minute, ovate-triangular, pubescent,  $\pm \frac{1}{3}$  mm long. Ovary hairy when young. Styles at last spreading or reflexed; filiform-subulate, hairy at the base,  $\pm 2\frac{1}{2}$  mm long. *Berries* red, 1–3 per catkin, ellipsoid, beset with broadly rounded tubercles, red,  $\pm 1$  cm long.

Distr. SE. Asia, Malay Peninsula, Sumatra, Banka, Billiton, Borneo, Java (rather rare and

local), Philippines, Lesser Sunda Islands (Bali, Lombok, Sumba, Flores), from the plains up to  $\pm 1700$  m.

Ecol. Light forest, jungles, locally numerous, with preference for dry, well-drained situations, in the Malay Peninsula both on hot sandy dunes and on stony laterites. *Fl. fr.* Jan.–Dec.

Vern. *Ki keper*, S, *samben*, *woru gesik*, J, *men-kikir(an)* (M, Bill.), *silom* (Bat.), *kětinah* (Sumba). Moreover, some local names. Mal. Peninsula: *Telur chickah*, *gělincek*, *kēsami*, *keteng*, *lěnteking*, *kay-teng*, *kusama*, *gilinche*.

Notes. The closely allied *M. rubra* (LOUR.) S. & Z. (*M. nagi* DC.; non THUNB. *quae est Podocarpus*!) seems to differ only by its larger ( $1\frac{1}{4}$ – $1\frac{1}{2}$  cm diam.) edible fruits, for which it is cultivated in Cochinchina, China and Japan. I have seen no authentic specimens and must refrain from pronouncing a definite opinion, whether it is specifically distinct.

Leaves of seedlings are stipulate, subsessile, narrowly lanceolate-obovate from a narrowly cordate base, acute, sharply and often coarsely serrate or often pinnatisect, thin, 20–35 by 5–7 cm; lateral nerves on either side of midrib up to 15; stipules narrowly ovate-lanceolate, very acute,  $\frac{1}{2}$ – $\frac{3}{4}$  cm long, deciduous. See also CORNER (1940) and STEEN. (Fl. Mal. I, 4, 1948, xx).

As the tree grows up the juvenile form passes very gradually into the adult form; lateral shoots of old trees may repeat the juvenile form.

#### INSUFFICIENTLY KNOWN MALAYSIAN FORMS OF MYRICA

(1) *Myrica* specimens, collected in 1912 by STRESEMANN on Mt Sofia in Central Ceram (no 20 and 132) and a ♂ specimen from Mt Togha, Buru (no 379), preserved in the herbaria at Leyden and Bogor, possess densely woolly young shoots, and crowded, oval-oblong, firmly coriaceous, very shallowly but distinctly serrate, 4–5 cm long,  $1\frac{1}{2}$ –3 cm wide *leaves* with an acute or obtuse base and an obtuse or rounded apex, in a young state densely woolly on both surfaces, glabrescent above except on the larger nerves, much more persistently hairy beneath, densely gland-dotted on the lower surface, much less densely so above; midrib much prominent beneath; lateral nerves on either side of midrib 4–8, rather widely patent, prominent beneath; petiole densely hairy,  $\frac{1}{2}$ –1 cm. No 20 is sterile; no 379 bears young male inflorescences, 6–7 cm long; main-axis densely woolly; catkins several,

spicate, patent, very dense,  $\pm \frac{3}{4}$  cm long; their rachis thinly patently short-hairy; floral bracts broadly ovate, densely woolly on the back,  $\pm 2$  mm long; stamens 4 or sometimes 3; filaments connate below; anthers vertical, thick, hairless, gland-dotted.

As the female flowers, the styles of which afford in this genus an important character, are as yet unknown I must refrain from naming it. It is certainly closely allied to *M. javanica* of which it may be a deviating form.

(2) The Arnold Arboretum Herbarium possesses a very small-leaved *Myrica* species collected in New Guinea (BRASS 10938, Oct. 1938), with very young ♀ flowers unfit for examination and description. It is clearly allied to *M. javanica* and may be one of the numerous forms of this very polymorphous plant.

#### Excluded

*Myrica luzonica* VIDAL, Sin. Atlas (1883) 40, t. 90, f. B; ROLFE, J. Linn. Soc. Bot. 21 (1884) 316

= *Sapium luzonicum* (VIDAL) MERR. (*Euphorbiaceae*).



## SONNERATIACEAE

(C. A. Backer & C. G. G. J. van Steenis, Heemstede/Leyden)

Trees. *Leaves* opposite, biseriate, exstipulate, simple, entire, coriaceous. *Flowers* ♂, either 1–3 together at the summits of the branchlets or in terminal corymbs, pedicelled, rather large, actinomorphic. Calyx thickly coriaceous, persistent, gamosepalous; segments 4–8, valvate in bud, acute, often coloured inside; tube of fruiting calyx flat or not. *Petals* either absent or as many as calyx-segments; in the latter case either broad and wrinkled or very narrow and smooth, alternating with the sepals. Stamens mostly many, sometimes 12, inserted on the calyx, often many-seriate, inflexed in bud; filaments filiform-subulate; anthers medifixed, reniform or oblong, 2-celled; cells opening lengthwise. Ovary superior, sessile with a broad base, during anthesis enclosed by the calyx-base, 4–∞-celled; septa thin; ovules numerous on thick, axile placentas. Style 1, long, robust; stigma 1, capitate, entire or slightly lobed. *Fruit* resting on the calyx-tube, either an indehiscent berry or a valvate capsule, many-seeded. Seeds small, exalbuminous.

Distr. Two small genera, one extending from tropical East Africa and adjacent islands to Queensland, Micronesia and Melanesia, the other confined to SE. Asia and Malaysia.

Ecol. *Sonneratias* are trees of the mangrove and seacoasts generally, *Duabanga* is a component of the evergreen rainforest belt. The flowers of *Sonneratia* are ephemeral and expand at sunset; they frequently emit an offensive smell and are conspicuous by a mass of exerted coloured stamens. The pollen is sticky acc. to VAN DER PIJL. For a discussion of the pollination see the notes under *S. caseolaris* (L.) ENGL. On the breathing roots of *Sonneratia* see under the genus.

Uses. The economic value of *Sonneratiaceae* is, on the whole, small. The wood is used for fuel, and for house- and boat-building. Of some *spp.* the fruit is eaten by the people. From the fruits of *Sonneratia* pectin can be extracted; see under *S. caseolaris* (L.) ENGL.

Wood anat. Compare next part.

Note. *Sonneratiaceae* (*Blattiaceae* NIEDENZU in E. & P. 3, 7, 1893, 16) are treated here in their strict sense. By various authors they have been merged with the *Punicaceae*, the *Lythraceae* or the *Myrtaceae*, often together with *Crypteroniaceae*.

### KEY TO THE GENERA

1. Flowers 1–3 together at the ends of the branchlets. Petals absent or very narrow, smooth. Stamens very many; anthers reniform. Fruit an indehiscent berry. Seeds not tailed at the ends . . . . . **1. *Sonneratia***
1. Flowers in 5- to rather many-flowered terminal corymbs. Petals broad, crisped. Stamens 12 or many; anther-cells curved or replicate over one end of the connective. Fruit a 4–8-valvate capsule. Seeds tailed at both ends by the protracted testa . . . . . **2. *Duabanga***

### 1. SONNERATIA

LINNÉ *f. Suppl.* (1781) 38 *nomen conserv.*—*Blatti* ADANS. *Fam.* 2 (1763) 88; O. K. *Rev. Gen.* 1 (1891) 238; NIEDENZU in E. & P. 3, 7 (1893) 20, *incl.* § *Eublatti* & § *Sciadostigma* NIEDENZU, *l.c.* 21.—*Pagapate* SONNERAT, *Voy. Nouv. Guin.* (1776) 16.—*Kambala* RAFIN. *Sylv. Tell.* (1838) 19.—*Mycostylis* RAFIN. *nom. altern. l.c.*—*Chiratia* MONTRous. *Mém. Ac. Lyon* 10 (1860) 202.—*Tombea* BRONGN. & GRIS, *Ann. Sc. Nat.* V, 1 (1864) 362, *nomen; ibid.* V, 6 (1866) 266; *Bull. Soc. Bot. Fr.* 13 (1866) 479.—**Fig. 1–5.**

All parts glabrous; trunk surrounded by ‘breathing-roots’ arising vertically from often very long horizontal roots buried at slight depth in the substratum; no buttresses. *Flowers* 1–3 together at the summits of the ultimate, mostly pendulous branchlets, 4–8-merous. Calyx-tube obconical or cup-shaped, under the ripe fruit either unaltered or flattened; segments ovate-oblong-triangular, often coloured inside. Petals very narrow or quite absent, caducous. Stamens very many, cadu-

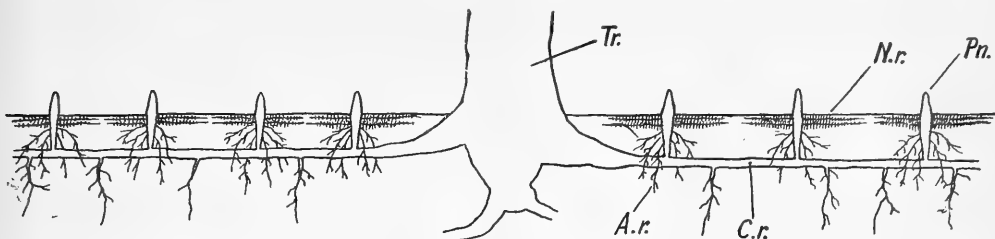


Fig. 1. Scheme of root-system in *Sonneratia*: Tr. = trunk, C.r. = cable-roots, Pn. = pneumatophores, N.r. = nutrition-roots, A.r. = anchor-roots. After TROLL.

cous; anthers comparatively small, reniform. Disk saucer-shaped. Ovary 10- or more-celled; style sinuous in bud. Fruit an indehiscent *berry*, depressed-globose, crowned by the style-base. Seeds embedded in evil-smelling pulp, not tailed at the ends.

Distr. Species 5, along the tropical shores of East Africa and adjacent islands, Asia, Hainan, *Malaysia* and N. Australia, to S. Riu Kiu Islands (Iriomote), Micronesia (Carolines: Ponape, Kusaie, Pelew, Yap, Truk, Palau, Korror), Melanesia (New Ireland, the New Hebrides, Solomon Islands), and New Caledonia. Not in Formosa!

Ecol. Inhabitants of coral-terraces (either inundated by flood or not), shallow parts of calm seas, the mangrove and the banks of tidal rivers and creeks.

The structure and functioning of the root-system of *S. caseolaris* has been studied by C. TROLL (Ber. D.B.G. 48, 1930, Gen.-Vers. Heft p. (81)–(99); Planta 13, 1931, 311–473; Trop. Natuur 22, 1933, 33–39). He has found that the so-called ‘aerophores’ are emitted by numerous long horizontal cable-roots and serve to produce fine nutrition roots penetrating horizontally in the uppermost layer of the steadily in-



Fig. 2. *Sonneratia*, old specimen, NE. Java, prostrate stems with oyster colonies (JESWIET).

creasing (rejuvenated) silt. The aerophores themselves do not serve for respiration; this function belongs to the nutrition roots the production of which follows the deposition of silt layers. These observations are *mutatis mutandis* valid for all mangrove aerophores or pneumatophores (fig. 1).

Uses. On the whole rather unimportant. The wood of *S. alba* is locally used for house- and boat-building, elsewhere only as (a rather inferior) fire-wood or not used at all. The young berries which have a sour taste are locally eaten; they are also used as a medicine. See for the extraction of pectin from the fruits under *S. caseolaris* (L.) ENGL.

Notes. There has been, in the past, a considerable confusion both in Malaysian and *extra*-Malaysian literature about the application of some specific names though two had been accurately described and figured by RUMPHIUS. This has partly been caused by the absence of complete herbarium materials with full field notes, and partly by the presence of two rather rare, ill-recognized *spp.* One should study the species *in situ* where they can easily be distinguished both in the flowering and fruiting states. The lack of good materials is to some extent due to the fact that the flowers are nocturnal and short-lived: petals and stamens soon fall out. For a proper identification a collector should note: the colour of the inside of the calyx, of the petals (in buds or *young flowers*), and the stamens, and the poise of the calyx under *adult* fruits. The leaf-shape is, generally, less important for specific distinction.

In order to define the proper geographical distribution of the species a revision has been made of the whole genus and type specimens have been examined. Of the 5 species distinguished, three occur in Malaysia, one extends to the Kra isthmus and one to Lower Burma; these two may be expected to turn up elsewhere in West-Malaysia.

As to literature, pure and applied, no attempt has been made to correct all erroneous records.

#### KEY TO THE SPECIES (*flowering material*)

1. Petals absent<sup>1</sup>.
  2. Stigma large fungiform, 6 mm through. Calyx 4-(exceptionally 6-)merous, 1 $\frac{1}{2}$ -2 cm long (incl. ovary). Leaves narrow. . . . . 4. *S. apetala*
  2. Stigma capitate, ca 3 mm diam. Calyx (5-)6-8-merous, 2 $\frac{1}{2}$ -4 $\frac{1}{2}$  cm long (incl. ovary).
    3. Calyx smooth throughout, not ribbed. Leaves obovate to suborbicular, 7-10 $\frac{1}{2}$  by 5-9 $\frac{1}{2}$  cm, rather thickish. Leaf base shortly contracted-decurrent. Nerves thickish, (*pro gen.*) distinctly prominent on the upper surface. . . . . 5. *S. griffithii*
    3. Calyx finely verruculose, tube distinctly ribbed and somewhat contracted at the rim; inner side of the segments strongly tinged red. Leaves broadly ovate or broadly oval to suborbicular, rounded or subcordate at the base, broadly rounded at the top, 4-10 by 3-9 cm. Nerves very thin, not distinctly prominent on the upper surface. . . . . 2. *S. ovata*
1. Petals present<sup>1</sup>.
  4. Petals linear, 13-20 by  $\frac{1}{2}$ -1 $\frac{1}{4}$  mm, white or in the lower half tinged with red. Inner side of the sepals red. Filaments white. Leaves obovate or oval from a cuneate base, apex broadly rounded, often emarginate, 5-12 $\frac{1}{2}$  by 3-9 cm . . . . . 3. *S. alba*
  4. Petals linear-lanceolate, dark red (also *statu sicco*), 16-35 by 1 $\frac{1}{2}$ -3 $\frac{1}{2}$  mm. Inner side of sepals greenish or yellowish-white. Filaments in their lower part red, upper part white. Leaves elliptic-oblong or oval-obovate, base contracted or cuneate, apex blunt or rounded, 5-13 by 2-5 cm. . . . . 1. *S. caseolaris*

#### KEY TO THE SPECIES (*fruiting material*)

1. Calyx 4-(exceptionally 6-)merous, ca 2 cm long (incl. ovary). Leaves narrow. Ovary 5-8-celled. Fruit 1 $\frac{1}{2}$ -2 cm diam. . . . . 4. *S. apetala*
1. Calyx (5-)6-8-lobed, 2 $\frac{1}{2}$ -4 $\frac{1}{2}$  cm long (incl. ovary). Ovary 14-21-celled. Fruit 2 $\frac{1}{2}$ -4 cm high, 3-7 $\frac{1}{2}$  cm diam.
  2. Calyx tube and lobes under the ripe fruit flat-expanded, tube at most obscurely ribbed.
    3. Leaves obovate to suborbicular, base rounded, shortly contracted into the petiole, apex broadly rounded or emarginate, 7-10 $\frac{1}{2}$  by 5 $\frac{1}{2}$ -9 $\frac{1}{2}$  cm. Nerves (*pro gen.*) distinctly prominent on the upper surface. . . . . 5. *S. griffithii*
    3. Leaves elliptic-oblong or oval-obovate, base contracted or cuneate, apex blunt or rounded, 5-13 by 2-5 cm; nerves very thin, often inconspicuous, not distinctly prominent and less strong than in the preceding species . . . . . 1. *S. caseolaris*
  2. Calyx under the ripe fruit cup-shaped or turbinate, its tube or its segments enveloping the base of the fruit, the tube ribbed.
    4. Tube of the fruiting calyx 1 $\frac{1}{2}$ -2 cm high, smooth, segments under the ripe fruit entirely reflexed. Leaves obovate or oval from a cuneate base, apex broadly rounded, often emarginate, 5-12 $\frac{1}{2}$  by 3-9 cm . . . . . 3. *S. alba*
    4. Calyx distinctly finely verruculose, tube of the fruiting calyx cupular,  $\frac{1}{2}$ -1 cm high; segments ascending, appressed against the ripe fruit. Leaves broadly ovate or broadly oval, rounded or subcordate at the base, broadly rounded at the apex, 4-10 by 3-9 cm. . . . . 2. *S. ovata*

(1) The often fugacious petals may be very narrow and inconspicuous, strongly resembling the filaments. They are best observed in mature buds.

1. *Sonneratia caseolaris* (L.) ENGL. in E. & P. Nachtr. (1897) 261, *em. Sm.* in REES, Cycl. (1819) xxxiii; MERR. Fl. Man. (1912) 344; DRUCE, Rep. Bot. Exch. Club Br. Isl. 1913, III, 424 (1914); MERR. Int. Rumph. Herb. Amb. (1917) 383; EN. BORN. (1921) 418; PARKER, Ind. For. 51 (1925) 507, *incl. var. mucronata* (MIQ.); BURK. Dict. (1935) 2052; STEEN. Fl. Sch. Indon. (1949) 292; *non* MERR. En. Philip. 3 (1923) 139 *et al.*—*Mangium caseolare rubrum* RUMPH. Herb. Amb. 3 (1743) 112, t. 74.—*Rhizophora caseolaris* LINNÉ *p.p.* in STICKMAN, Herb. Amb. (1754) 13; AMOEN. Acad. 4 (1759) 123; Syst. ed. 10 (1759) 1043; Sp. Pl. ed. 2 (1763) 635; BURM. f. Fl. Ind. (1768) 635.—*Pagapate* SONNERAT, Voy. Nouv. Guin. (1776) 16, t. 10–11.—*Sonneratia acida* LINNÉ f. Suppl. (1781) 252; SMITH in REES, Cycl. (1819) 33, no 1; ROTH, Nov. Sp. (1821) 233; DC. Prod. 3 (1828) 231; ROXB. Fl. Ind. ed. CAREY 2 (1832) 506; W. & A. Prod. (1834) 327; DECNE. Nouv. Ann. Mus. 3 (1834) 454; WIGHT, Ic. 2 (1843) 340; GRIFF. Not. Syst. 4 (1854) 652; SPAN. Linnaea 15 (1841) 203; KORTH. Ned. Kruidk. Arch. 1 (1846) 198; BL. Mus. Bot. 1 (1851) 336; GRIFF. Not. 4 (1854) 652; MIQ. Fl. Ind. Bat. 1, 1 (1856) 496 *incl. var. mucronata* MIQ.; Suppl. Sum. (1860) 120, 316; DALZ. & GIBBS. Bomb. Fl. (1861) 98; BRAND. For. Fl. (1874) 242; KURZ, For. Fl. 1 (1877) 526; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1879) 579; K. & V. Bijdr. Booms. 1 (1894) 198; KOORD. Exk. Fl. 2 (1912) 663; KOORD. Atlas Baumart. (1915) t. 592–594; BACK. Bull. J.B.B. III, 2 (1920) 330; GUILL. & GAGN. Fl. I.C. 2 (1921) 980; RIDL. Fl. Mal. Pen. 1 (1922) 825; MERR. En. Philip. 3 (1923) 138; MEIND. Tect. 15 (1922) 573, f. 18; Trop. Natuur 12 (1923) 77, f. 18; HEYNE, Nutt. Pl. (1927) 1156; WATSON, Mal. For. Rec. 6 (1928) 121, f. 22; RIDL. Disp. (1930) 293; KINT, Trop. Natuur 23 (1934) 182; v. D. PIJL, Flora 131 (1936) 25, f. 16; BACK. Bekn. Fl. Java *em. ed.* 4 (1942) fam. 73, p. 2.—*Aubletia caseolaris* GAERTN. Fruct. (1788) 379, t. 78, f. 2, *pro parte*.—*Blatti acide* LAMK, Enc. 1 (1789) 429.—*S. pagatpat* BLANCO, Fl. Filip. (1837) 424, *ed.* 2 (1845) 496, *ed.* 3, 2 (1878) 186; BL. Mus. Bot. 1 (1851) 337; MIQ. Fl. Ind. Bat. 1, 1 (1856) 496.—*S. rubra* OKEN, Allg. Naturgesch. 3<sup>3</sup> (1841) 1952; *cf.* MERR. J. Arn. Arb. 31 (1950) 285.—*S. ovalis* KORTH. Ned. Kruidk. Arch. 1 (1846) 198.—*S. neglecta* BL. Mus. Bot. 1 (1851) 338.—*S. evenia* BL. l.c.; MIQ. l.c. 497.—*S. lanceolata* BL. l.c.; MIQ. l.c. 497; KOORD. Minah. (1898) 471.—*S. obovata* BL. l.c.; MIQ. l.c. 497.—*Blatti caseolaris* O.K. Rev. Gen. 1 (1891) 238, NIEDENZU in E. & P. 3, 7 (1891) 21, *pro parte*.—*Blatti pagatpat* NIEDENZU in E. & P. 3, 7 (1891) 21.—Fig. 3c.

*Tree*, 5–15 m, rarely up to 20 m, with many often very strong breathing-roots and a rather lax crown. Ultimate branchlets drooping, when young obtusely quadrangular, rarely sharply 4-angled, occasionally even narrowly 4-winged; in the latter case the internodes often quadricornute at the apex. *Leaves* variable in shape, elliptic, oblong or oval to obovate from a contracted or cuneate base, blunt or rounded at the apex, mucronate or not, 5–13 by 2–5 cm; on either side of the rather strong midrib with 8–12 more or less widely patent very

thin, often inconspicuous lateral nerves, light green; petiole broad, very short, frequently almost obsolete. Flowerbuds broadly oval, with a rounded or very obtuse apex, less than twice as long as broad. *Flowers* (5–)6–8-merous. Calyx tube during anthesis shallowly cup-shaped, smooth; tube not or hardly ribbed; segments usually distinctly longer than the tube, inner side greenish- or yellowish-white. Petals linear-lanceolate, dark red,  $1\frac{3}{4}$ – $2\frac{1}{2}$  cm by  $1\frac{1}{2}$ –3 mm. Filaments  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long, in their lower part red, in their upper part white. Ovary 16–21-celled. Segments of fruiting calyx sub-horizontally spreading. Ripe *berry* resting on the flattened calyx-tube, green, 3–4 cm high, 5– $7\frac{1}{2}$  cm broad.

*Distr.* Tropical SE. Asia & Ceylon to N. Australia, Solomon Islands, and New Hebrides, in *Malaysia*: Malay Peninsula, Sumatra (also Simalur & Banka), Java (also Madura), Borneo, Celebes, Philippines, Moluccas (Ambon, Buru), Timor, New Guinea.

*Ecol.* Less salt parts of mangrove-forests on a deeply muddy soil, *never* on coral-banks, often along tidal creeks with slow-moving water and ascending these as far as the flood mounts. In anthesis the flowers contain abundant honey. Fl. Jan.–Dec.

BECCARI (Nelle for. di Borneo 1902, p. 140, *in ann.*) makes the following observation:—‘On ascending the Sarawak one encounters, after passing Kuching, always in great numbers the *kayu p’dada* or *peddada*, i.e. *Sonneratia lanceolata* BL. (in my opinion only a variety of *Sonneratia acida*), which inhabits not only estuaries but can also grow in localities where the water is occasionally fresh. The leaves of this plant have the power of shifting, during heavy rains, the position of their blades from horizontal (as is usually the case) to vertical. I have observed this fact for the first time not in Borneo, but during my journey to Kendari in Celebes (1874) along the streambed of the river Lepo lepo, where I have also noticed that the flowers of *Sonneratia*, which, being nocturnal, are closed in the day-time, are visited by honey-eating birds in the evening and the first hours of the morning.’ DOCTERS VAN LEEUWEN (Ann. J.B.B. 37, 1927, 26) supposes that the flowers are pollinated by large night-moths. VAN DER PIJL (Flora 131, 1936, 25–26, f. 16) saw bats drinking the nectar, with which the cupshaped torus is filled. BRASS mentions a thickened leaf apex which might point to guttation pores. LANE-POOLE saw in the Gulf of Papua ‘*S. acida* as a resting tree for fireflies gathering in such numbers on certain individual trees that at night the whole tree is lit with a soft greenish glow which is often quite distinctly reflected in the water’.

*Uses.* The young berries, which have a sour taste, are eaten by the people; they wood is used for fuel but as such only when better fire-wood is unavailable. The breathing roots, after having been boiled in water, furnish an inferior substitute for cork.

TH. M. MEIJER, L. DE VOS & J. P. J. SAMWEL described the extraction and properties of pectin extracted from the fruits (De Ingenieur in Ned. Indië 7 (sect. 5), 1940, no 9, p. 5–7, f. 1).

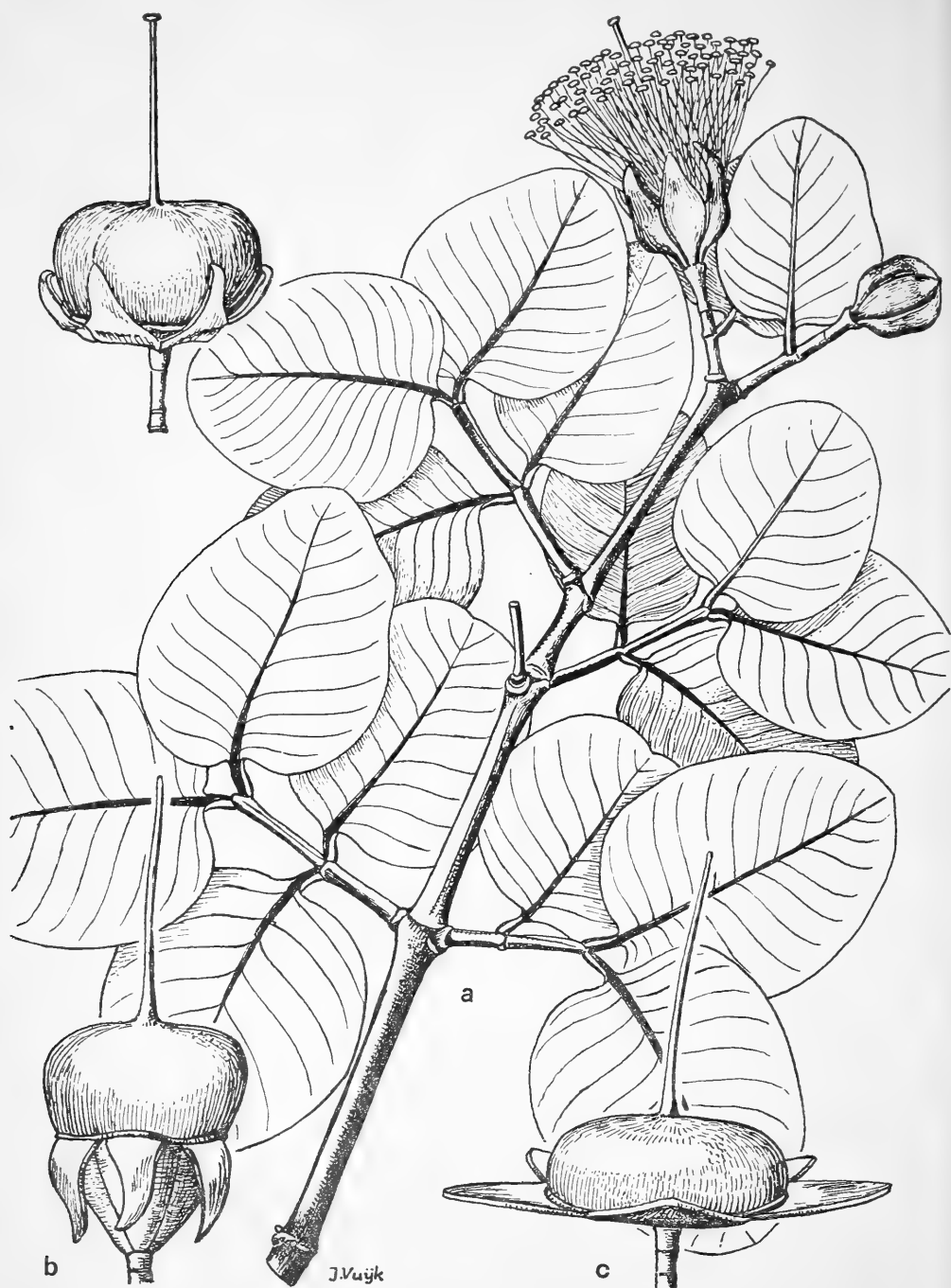


Fig. 3. a. *Sonneratia ovata* BACKER, flowering twig and fruit, b. *S. alba* J.SM., fruit, c. *S. caseolaris* (L.) ENGL., fruit,  $\times \frac{2}{3}$ .

Vern. Many names the commonest of which are: *Pédada*, *pérèpat*, *pidada*, M, *bidada*, J, *bogëm*, S, with local variants, *bèrèmbang* (Mal. Pen.). Philippines: *Patagpat*, *palatpát*, *hikau-hikáuan* (Tag.), *ilukabbán*, *lukabbán* (Ibn.), *payar* (Pang.).

Nomencl. There has been a considerable confusion both in the identification and application of the specific names in *Sonneratia*, due to the fact that LINNÉ typified *Rhizophora caseolaris* L. (1754) by a reference to *Mangium caseolare* RUMPH., the title of a chapter treating two different plants viz *Mangium caseolare album* and *Mangium caseolare rubrum*. LINNÉ f. not aware of this, founded *Sonneratia acida* L. f. n.g.n.sp. solely on *Parapate* of SONNERAT without reference to his father's *Rhizophora caseolaris*. GAERTNER, when publishing *Aubletia caseolaris* (De Fruct. 1788, 379), quoted in synonymy *Mangium caseolare album* but from his description and plate (t. 78, 2) it appears that he made, again, no distinction between the two Rumphian plants.

In 1819 Sir J. E. SMITH (in REES Cyclop. xxxiii) disentangled the confusion by segregating and typifying the two species which RUMPHUS had described. He singled out *S. alba* (based on *Mangium caseolare album* RUMPH.) as a new species. The other part of *Rhizophora caseolaris* (based on *Mangium caseolare rubrum*) he identified—as had been done previously by LAMARCK (Dict. 1, 1789, 429)—with *Sonneratia acida* L. f. which he adopted as its proper name as it was amply described and well distinguished.

For the question to which segregate of *Rhizophora caseolaris* L., which, according to art. 52 of the Rules, to our regret should be preserved and retypified, we have considered that SMITH intentionally gave a new name for a part of the type thus having accomplished the retypification himself, leaving the old name of LINNÉ for the rest, that is *Mangium caseolare rubrum* RUMPH. = *Rhizophora caseolaris* L. p.p.em. (syn. *S. acida* L. f.). MERRILL (Fl. Man. 1912, p. 344 and Interpr. Rumph. Herb. Amb. 1917, p. 383) did the same, though he later reversed his opinion (En. Philip. Fl. Pl. 3, p. 138) but he states to have not seen the original literature.

**2. *Sonneratia ovata* BACKER**, Bull. J.B.B. III, 2 (1920) 329; MEIND. Tect. 15 (1922) 573, f. 19; Trop. Natuur 12 (1923) 77, f. 19; STEEN. Bull. J.B.B. III, 12 (1931) 162; MERR. & PERRY, J. Arn. Arb. 22 (1941) 269; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 2.—*S. alba* auct. plur.; WATSON, Mal. For. Rec. 6 (1928) 120, 122, f. 23.—Fig. 3.

Small or medium-sized tree, 2–5(–20) m high; young branchlets obtusely quadrangular. *Leaves* broadly ovate or oval to orbicular, rounded or subcordate at the base, broadly rounded at the top, 4–10 by 3–9 cm; lateral nerves several, widely patent, very thin; petiole 2–15 mm. *Flowers* solitary or 3 together; pedicels 1–2 cm, sometimes none. Buds broadly oval, with a rounded or very obtuse apex, less than twice as long as broad, finely verruculose, in anthesis 2½–3 cm long, tube widely cupular from an abruptly contracted, shortly stipitiiform base; ribs decurrent down the stalk-like lower

part. Segments usually 6, ovate-triangular, during anthesis as long as the tube or slightly longer, their inner side strongly tinged with red, in fruit appressed to the berry. Petals absent. Filaments white. Ovary 13–15-celled. Ripe berry 3–4¾ cm broad, 2½–3½ cm high.

Distr. Siam (KERR 17875, 14246, 4345, PUT s.n., A. MAREAN 673), in *Malaysia*: Malay Peninsula (Singapore; Sg. Menyala in Negri Sembilan, CF 571; MAINGAY 654), Riouw Arch. (Siantan in the Anambas Islands), Java (also in Karimondjawa Islands), S. Celebes, Moluccas (Sula Islands), SE. New Guinea (Daru Island). Fig. 5.

Ecol. Land-side of tidal forests in the less salt parts on a muddy soil, along tidal creeks, never on coral-reefs. Locally numerous but, on the whole, rather rare. Fl. Jan.–Dec.

Vern. *Gédabu* (Mal. Pen.).

**3. *Sonneratia alba* J. SMITH** in REES, Cycl. 33 (1819) no 2; DC. Prod. 3 (1828) 231; BL. Mus. Bot. 1 (1851) 338; MQ. Fl. Ind. Bat. 1, 1 (1856) 497; KURZ, For. Fl. (1877) 526; HOOK. f. Fl. Br. Ind. 2 (1879) 580; BISSCHOP-GREV. Pl. Ned. Ind. (1883) 163; K. & V. Bijdr. Booms. 1 (1894) 200; KOORD. Minah. (1898) 470; BAILEY, Queensl. Fl. (1900) 679; BECC. Nelle For. di Borneo (1902) 579; KOORD. Ekk. Fl. 2 (1912) 663; MERR. Interpr. Herb. Amb. (1917) 383; BACK. Bull. J.B.B. III, 2 (1920) 330; MERR. En. Born. (1921) 418; MEIND. Tectona 15 (1922) 573, f. 17; Trop. Natuur 12 (1923) 77, f. 17; HEYNE, Nutt. Pl. (1927) 1156; RIDLEY, Disp. (1930) 293; TROLL, Trop. Natuur 22 (1933) 33–39 cum ic.; KINT, Trop. Natuur 23 (1934) 173–189, f. 9; BURK. Dict. (1935) 2051; KANEHIRA, J. Jap. Bot. 14 (1938) 423, f. 3 A–K; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 2; STEEN. Fl. Sch. Indon. (1949) 292.—*Mangium caseolare album* RUMPH. Herb. Amb. 3 (1743) 111, t. 73.—*Rhizophora caseolaris* LINNÉ in STICKMAN, Herb. Amb. (1754) 13, *pro parte*.—*Chiratia leucantha* MONTR. Mém. Ac. Imp. Sc. Lyon 10 (1860) 203.—*S. mossambicensis* KLOTZSCH ex PETERS, Reise Mossamb. Bot. 1 (1862) 66, pl. 12.—*Blattia alba et leucantha* O.K. Rev. Gen. 1 (1891) 238; NIEDENZU in E. & P. 3, 7 (1893) 21.—*Sonneratia caseolaris* ENGL. in E. & P. Nachtr. (1897) 261, *ex parte*; sensu MERR. En. Philip. 3 (1923) 139.—*S. griffithii* (non KURZ) WATSON, Mal. For. Rec. 6 (1928) 120, 121, f. 24.—*S. iriomotensis* MASAMUNE, Syokubutu-tirigaku fig. 71 (1936), cf. MASAM. Trans. Nat. Hist. Soc. Formosa 29 (1939) 272, in syn. = *S. alba* var. *iriomotensis* MASUM. cf. YAMAMOTO, J. Soc. Trop. Agric. Taihoku 12 (1940) 162.—Fig. 3b.

Tree, 3–15(–20) m high, with many breathing roots (these, on the whole, less robust than those of *S. caseolaris*) and a broad, rather lax crown. *Leaves* emucronate, obovate or oval from a cuneate base, broadly rounded at the top, often emarginate, 5–12½ by 3–9 cm, rather thickly coriaceous, on either side of the rather strong midrib with 11–14 widely patent, very thin, sometimes hardly conspicuous lateral nerves; petiole stout, flattened on the anterior side, 3–10 mm. Flowerbuds oblong, narrowed at base and apex, 2–3 times as long as

broad. *Flowers* solitary or 3 together, 6–7–(8)-merous. Calyx in flower 3–3½ cm long; tube obconical or campanulate from a contracted base, distinctly angular, angles as many as segments and alternating with them; segments ovate-oblong, usually conspicuously shorter than the rest of the calyx, 1½–2 cm long, outside green, inside red, during anthesis more or less erect, under the ripe berry entirely reflexed. Petals in young flowers always present but very inconspicuous, strikingly resembling the filaments, 13–20 by ½–1¼ mm, white or in the lower half more or less tinged with red. Filaments white. Ovary 14–18-celled. Tube of fruiting calyx conspicuously obconical-turbinate, 1½–2 cm high. Ripe berry ± 3 cm high, ± 4 cm broad.

Distr. N. Madagascar, Seychelles and trop. E. Africa, SE. continental Asia and Andamans to N. Australia, S. Riu Kiu Islands (Iriomote), Micronesia (Pelew), Solomon Islands, the New Hebrides and N. Caledonia, in *Malaysia*: Malay Peninsula, Sumatra (also Enggano & Banka Islands), Java (also coral-islands in and before the Bay of Djakarta, Bawean, Madura & Kangean Islands), Lesser Sunda Islands (Bali), Borneo (also Pulu Laut), Celebes (also Saleier & Muna Islands), Philippines, Moluccas, New Guinea & New Ireland.

Ecol. Shallow parts of calm seas, seashores, along the mouth of tidal creeks. Prefers salt water and grows as well on a sandy or rocky as on a muddy soil, not rarely on coral-terraces. Often gregarious and predominating, but usually not forming a dense growth, except sometimes where better fuel-trees have been destroyed. In closed forest the clear bole may attain 15 m.

Uses. In the Minahasa (NE. Celebes) the wood is valued for ship- and house-building (under the roof). Elsewhere it is only used as fire-wood or not used at all.

Vern. Names as those of *S. caseolaris*. More-over: *Posi-posi* (Ternate). Philippines: *pagatpát* (general); *bunayon* (C. Bis.), *buñgálon* (P. Bis.), *palálan*, *pirara*, *pédada* (Mag.), *daliúru-laláki*, *palapát*, *palaspát*, *palatá*, *palapát* (Tag.), *patpát* (Mbo).

Notes. The fragment of the type of *S. mossambicensis* at Kew is insufficient for critical examination; as all other African sheets from Somaliland, Zanzibar (GREENWAY 1355), Pemba and Mafia Islands, Tanga Bay, Luabo River at Zambesi mouth (KIRK), the Seychelles (Aldabra group), and N. Madagascar (BARON 6631, 6733, Nossi-bé, J. M. HILDEBRANDT 3133) between 1° and 19° S.L. belong to *S. alba* J.S.M., we accept the type to belong to this species, notwithstanding the fact that in the type description the fruit (ripe?) is drawn with appressed lobes and petals are said to be absent.

*S. alba* appears to be the most widely distributed species both towards Africa and the West Pacific.

4. *Sonneratia apetala* BUCH.-HAM. in SYMES, Embassy Ava 3 (1800) 477, *cum tab.*; SCHRADER, J. f. d. Bot. II, i, II (1800) 252–253, t. 7; SM. in REES, Cycl. (1819) 33, no 3; ROTH, Nov. Sp. (1821) 233; DC. Prod. 3 (1828) 231; ROXB. Fl. Ind. ed. CAREY 2 (1832) 506; W. & A. Prod. (1834) 327; GRIFF. Not.

4 (1854) 650; KURZ, For. Fl. Burma 1 (1877) 527; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1879) 579; GAMBLE, Fl. Madr. 3 (1919) 515; PARKER, Ind. For. 51 (1925).—*Kambala apetala* RAFIN. Sylv. Tell. (1838) 19.—*Blatti apetala* O.K. Rev. Gen. 1 (1891) 238; NIEDENZU in E. & P. 3, 7 (1893) 21.

Medium-sized tree up to 12 m; twigs pendulous. *Leaves* sparse, 5½–13 by 1½–3¾ cm, gradually tapering towards the apex, attenuate at the base; nerves and veins indistinct; petiole ½–1 cm. Inflorescence mostly 3-flowered. Buds oblong, 1½ cm long. *Calyx* (incl. tube and lobes) in flower ± 1½–2 cm long, smooth, not ribbed; segments twice as long as the tube. Ovary 5–8-celled, nearly free from the calyx. Stigma in bud roofing over the androecium, but little protruding above it, during anthesis flattening and broadening, up to 7 mm diam., papillose, persistent. *Fruit* pale, broader than high, broadly globose; walls not thickened, 12–18 mm high, ± 2¼ cm diam. *Calyx* tube flat (as in *S. caseolaris*), lobes under the ripe fruit apparently horizontally expanded or subreflexed.

Distr. India (Sunderbuns, the Deccan as far as the Concan, Madras, Bombay, Orissa, Transganges Peninsula to Chittagong, Pegu, and Moulmein), and Ceylon, to be expected in the Malay Peninsula and elsewhere in *West Malaysia*.

Ecol. A well-characterized species, on the whole much less common than *S. alba* and *S. caseolaris*. In a specimen all stigmas were covered by adhering quartz sand which suggests that they are sticky.

Note. The only ovary available to us was 5-locular. The only specimen cited by TRIMEN (Handb. Fl. Ceyl. 2, 1894, 230) from Kotiyar possesses 6 sepals and may be distinguished as *f. hexasepala*, *f. nov.* (TRIMEN, Aug. 1885).

5. *Sonneratia griffithii* KURZ, J. As. Soc. Beng. 40, ii (1871) 56, *in clav.*; Pegu Rep. App. B (1875) 54, *in clav.*; For. Fl. Burm. 1 (1877) 527; CLARKE, Fl. Br. Ind. 2 (1879) 580; RIDL. Fl. Mal. Pen. 1 (1922) 825, *p.p.*; PARKER, Ind. For. 51 (1925) 507, 510; CRAIB, Fl. Siam. En. 1 (1931) 732; *plur. auct. p.p.*—*Sonneratia alba* (non SM.) GRIFF. Posth. Pap. 4 (1854) 652; WATSON, Mal. For. Rec. 6 (1928) fig. 23.—*S. acida* var. *griffithii* KING, J. As. Soc. Beng. 67, 2 (1898) 11.—Fig. 4.

Tree, 5–20 m tall, up to 1 m diam. *Leaves* obovate to suborbiculate, base rounded, shortly contracted into a short petiole, apex broadly rounded to subemarginate, texture rather thickish, nerves 10–12, (*pro gen.*) distinct, strongish, distinctly prominent on the upper surface, obliquely ascending; blade 7–10½ by 5½–9 cm. Mature bud 2½–3 cm long. *Flowers* greenish-white (PARKER). *Calyx* entirely smooth and not ribbed, tube rather wide-campulate from a suddenly contracted base. Lobes 6–7, in fruit together with the tube horizontally expanded, not enveloping the base of the fruit, 6½ cm diam., thick. *Fruit* 2½–3 cm high, 4–5½ cm diam., hard, many-celled, apex very broadly rounded; style apparently less persistent than in *S. caseolaris* (= *acida*). Type: GRIFFITH 2433.<sup>1</sup>

(1) GRIFFITH 2432 = *S. alba* J.S.M.



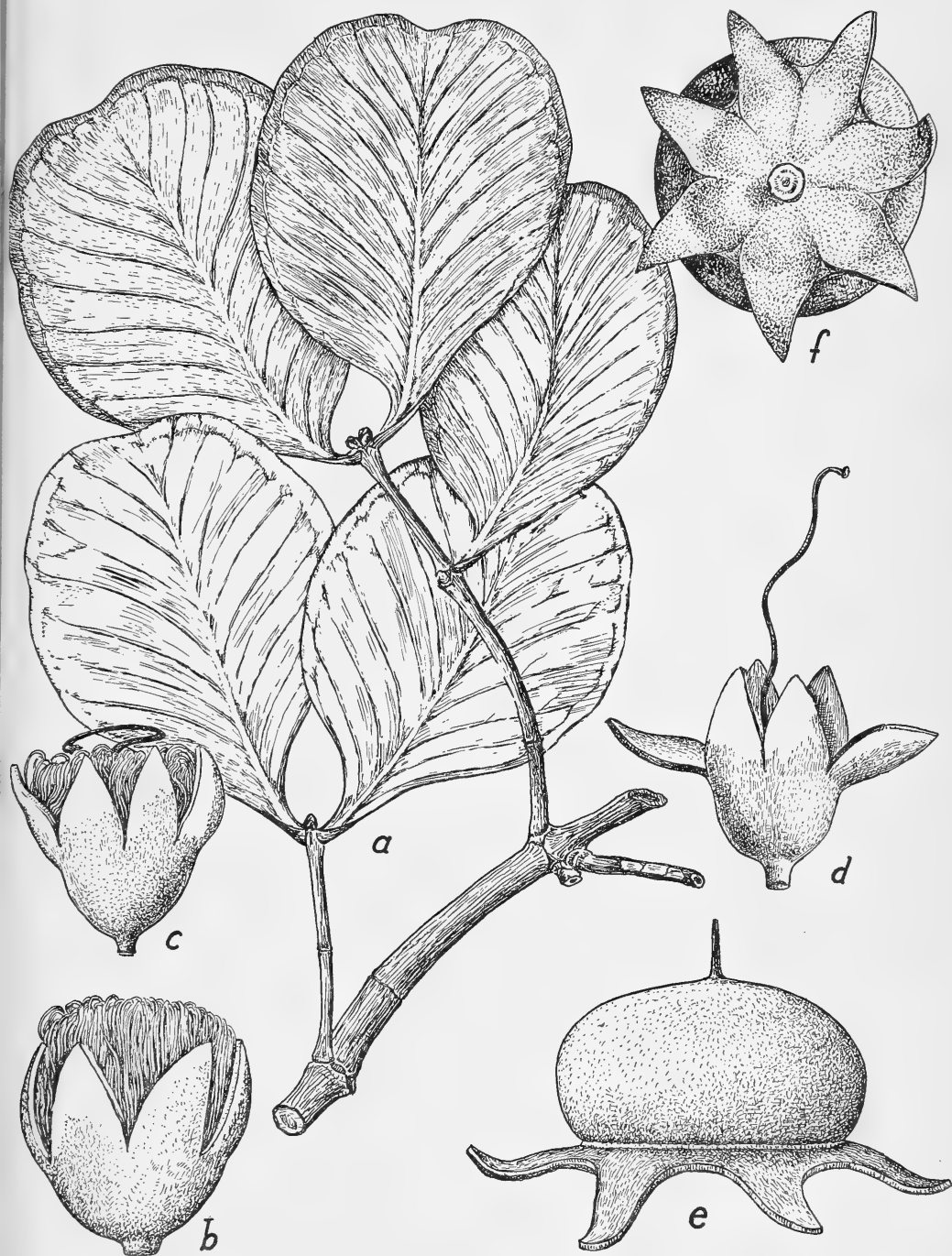


Fig. 4. *Sonneratia griffithii* KURZ. a. Twig (LACE 2966),  $\times 2/3$ , b. opened bud (KERMODE 7136), nat. size, c. ditto (KERR 16548), nat. size, d. flower beyond anthesis (KERR 16548), nat. size, e. ripe fruit, lateral (KERR 14246), nat. size, f. ditto, basal (LACE 2966),  $\times 2/3$ .



Distr. Bengal (Chittagong Div., pr. Srimai, COWAN 208), Burma (Myaungmya distr., Polaung, LACE 2966, Bassein village, near Tazin, KERMODE 7136), Lower Siam (Puket distr. Satul, KERR 14246, Ranauwng, KERR 16548), Mergui (PARKER, *l.c.*), Andamans (PARKER, *l.c.*), in *Malaysia*: W. Malay Peninsula (SCORTECHINI 967, KING, *l.c.*). Fig. 5.

Ecol. Said to be common in mangrove swamps, but it is scarce in herbaria, of which the above is a complete enumeration; LACE says: 'in places frequent on banks of streams, sends up many sharp-pointed aerophores'; KURZ defines its occurrence: 'common in littoral forests from Pegu down to Tenasserim, ascending the rivers as far as they are brackish'. *Fl. Jan.* (Siam), *fr. Jan.* (Siam), March (Burma), April (Bengal).

Note. Allied to, but distinctly differing from *S.*

*caseolaris* (L.) ENGL.; by several authors confused with other species.



Fig. 5. Localities of *Sonneratia ovata* BACKER (+) and *S. griffithii* KURZ (•).

## 2. DUABANGA

BUCH.-HAM. Trans. Linn. Soc. Lond. 17 (1835) 177-178.

Buttressed tall trees with pendulous ultimate branches. *Leaves* glaucous beneath. *Flowers* in terminal, 5- to many-flowered corymbs, 4-8-merous. Calyx-tube obconical or cupshaped, segments triangular-ovate. Petals shortly clawed, broad, crisped. Stamens 12 or many, filaments long, filiform-subulate from a broadened base; anther recurved or replicate over one end of the connective. Ovary 4-8-celled, stigma thick, lobed. *Capsule* loculicidally 4-8-valved. Seeds tailed at both ends by the produced testa.

Distr. Species two, SE. Asia and *Malaysia* (as far E as New Guinea). Fig. 6.

Ecol. Evergreen forests.

Uses. Wood used for house- and boat-building.

### KEY TO THE SPECIES

1. Flowers and fruit 4-merous. Calyx-tube obconical. Stamens 12. Anther-cells narrowly hairpin-shaped; extrorse arm of hairpin about half as long as introrse arm, closely applied to it and adnate to it.

1. *D. moluccana*

1. Flowers and fruit 5-8-merous. Calyx-tube widely cup-shaped. Stamens more than 50, biseriate. Anther-cells recurved but not narrowly hairpin-shaped; extrorse arm of curve much less than half as long as introrse arm, not closely applied to it and not adnate to it . . . . . 2. *D. grandiflora*

1. *Duabanga moluccana* BL. Mus. Bot. 1 (1849) 109; MIQ. Fl. Ind. Bat. 1, 1 (1855) 625; TEYSM. Nat. Tijds. N.I. 11 (1856) 186; VIDAL, Sin. Atl. (1883) t. 52, f. F; K. & V. Bijdr. Booms. 1 (1894) 195; KOORD. Minah. (1898) 469; EXK. Fl. 2 (1912) 663; Atlas Baumart. (1918) t. 784; MERR. En. Philip. 3 (1923) 139; HEYNE, Nutt. Pl. (1927) 1157; MERR. Pl. Elm. Born. (1929) 212; DE VOOGE, Trop. Natuur 27 (1938) 177-178, f. 4; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 3; HOLTHUIS & LAM, Blumea 5 (1942) 216.—*D. borneensis* R. KNUTH, Fedde, Rep. 38 (1935) 121.

*Tree*, 25-35 m, sometimes up to 45 m, 0.70-1.00 m thick; trunk columnar, unbuttressed. Very young branchlets and both surfaces of very young leaves rather densely clothed with appressed short thickish brown hairs, very soon glabrescent; young branchlets obtusely quadrangular, becoming terete with age. *Leaves* ovate, oblong or lanceolate from a shallowly cordate base, acuminate, firmly coriaceous, on either side of the (on the lower surface)

much prominent costa with numerous widely patent arcuate lateral nerves inarching near the margin and forming there a strong intramarginal nerve, darkgreen above, paler beneath, 7-30 by 4-12 cm; petiole 4-8 mm. *Corymbs* few- to rather many-flowered, 4-15 cm across, dense or rather lax, at first finely pubescent, afterwards glabrous. Pedicels thick, 1-1½ cm (in bud ½ cm, in fruit to 3½ cm). Buds ovoid-oval, shortly acuminate, with 4 longitudinal ribs (formed by the contiguous margins of the sepals). *Flowers* inodorous? Calyx when fully expanded during anthesis ± 2½ cm diam., afterwards slightly enlarged; segments shortly acuminate, acute, under fruit patent or reflexed. *Petals* caducous, shortly clawed, oval, yellowish, about as long as sepals. Stamens 1-seriate, on a narrow circular rim; filaments with a broadly linear lower half and a filiform-subulate upper half; anthers at first yellow, afterwards brown. Style pale green; stigma dark green or red. *Capsule* ovoid-oblong, 2½-3 cm long, 4-valved.

*Seeds* ∞, 5–6 mm long (2–2½ mm long tails included); nucleus ± 1 mm.

*Distr.* *Malaysia*: Java (only easternmost part), Lesser Sunda Islands (Bali, Lombok, Sumbawa), Borneo, Celebes, Talaud, Philippines, Moluccas (Halmahera, Ternate, Batjan, Ambon, Ceram), New Guinea. Fig. 6.

*Ecol.* Evergreen forests, 60–1200 m, in NW. Sumbawa observed to predominate in majestic trees on the slope of Mt Tambora, possibly also occupying this position in E. Flores.

*Uses.* Wood used for house- and boat-building.

*Vern.* In Java: *Takir*, J, *takèr*, Md; in Bali: *kadjimas*; in Lombok: *radjumas*; in Talaud: *waròh*. Further several local names. Philippines: *Adha*, *adka*, *karauan*, *lubtub* (Bik.), *agas*, *banabang-bug-tong*, *binuang*, *buluang*, *loktob*, *loktok*, *lokton*, *luk-tub*, *malapalikpik* (Tag.), *arik*, *kadig* (Ibn.), *bukag*, *kadil*, *kadir* (Ilk.), *buyukan* (God.), *dahà* (Mbo, P. Bis.), *dapul* (Ting.), *hoi* (Bon.), *iloilo* (P. Bis.), *ka-dèl*, *karig* (Neg.), *lamod* (Mag., Bag.), *lutub* (Sul.).

**2. *Duabanga grandiflora* (ROXB. ex DC.) WALP.** Rep. 2 (1843) 114; BLUME, Mus. Bot. 1 (1849) 109; T. & B. Cat. Hort. Bog. (1866) 241; KURZ, Pegu Rep. App. B (1875) 54.—*Lagerstroemia grandiflora* ROXB. (Hort. Beng. 1814, p. 38) ex DC. Mém. Soc. Hist. Nat. Genève 32 (1826) 84; Prod. 3 (1828) 93; ROXB. Fl. Ind. ed. CAREY 2 (1832) 503.—*D. sonneratioides* BUCH.-HAM. Trans. Linn. Soc. 17 (1835) 177–178; Hook. f. Ill. Himal. Pl. (1855) t. 11; KURZ, For. Fl. 1 (1877) 525; CLARKE in Hook. f. Fl. Br. Ind. 2 (1879) 579; KING, J. As. Soc. Beng. 67, 2 (1898) 10; RIDL. Fl. Mal. Pen. 2 (1922) 824; BURK. Dict. 1 (1935) 869; CORNER, Wayside Trees (1940) 427, atl. f. 127–128; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 3.—*Leptospartion grandiflorum* GRIFF. Ic. Pl. As. 4 (1854) 591.

*Tree*, 18–30 m, scarcely buttressed, glabrous in all its parts; branches drooping, young branchlets obtusely quadrangular. *Leaves* ovate-oblong from a broad, cordate or rounded base, shortly acuminate, on both sides of the (on the lower surface) much prominent costa with numerous widely patent arcuate lateral nerves, glaucous beneath, 10–30 by 5–10 cm; petiole robust, 3–8 mm; flush reddish pink. Corymbs drooping, rather many-flowered, ± 15 cm across, rather lax. Pedicels robust, 3–4 cm. *Calyx*-tube widely cup-shaped, segments ovate, acute, 2¼–2½ cm. Petals shortly clawed, with an oval, rounded crisped blade, white, 2½–3½ by 1½–2½ cm. Stamens upwards of 50; filaments filiform from a slightly broadened base, white; anthers very mobile, curved but not narrowly hairpin-shaped. Free top of ovary broadly conical; stigma slightly lobed, darkgreen. *Capsule* subglobose, green, eventually turning brown and splitting with 5–7 longitudinal clefts.

*Distr.* From the S. slopes of the E. Himalaya (Sikkim) to Assam, Burma, Siam, Yunnan, Laos,

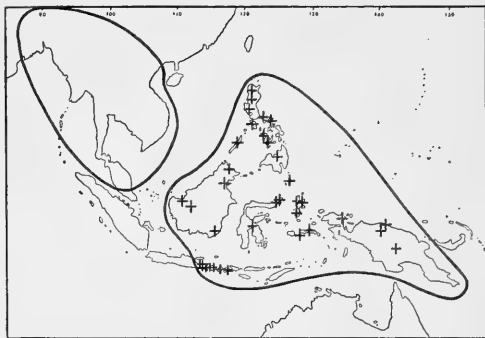


Fig. 6. Area of distribution of the genus *Duabanga*: *D. grandiflora* (ROXB.) WALP. (left) and *D. moluccana* BL. (right; localities indicated by +).

Kambodja, Cochinchina, Annam, Tonkin, and Andamans, extending to *Malaysia*: Malay Peninsula (as far as Negri Sembilan). The areas of this and the preceding species do not touch, much less overlap. Statements to the contrary are either entirely wrong or must be based on cultivated specimens. Fig 6.

*Ecol.* RIDLEY (Disp. 1930, p. 119) says: 'It is an inhabitant of forests in the Malay Peninsula, where it is widely scattered, but not common. The trees are sporadic, at some considerable distance from each other. It appears to prefer loose open soil, which is not to be found in a large quantity in dense tropical forests; but the very numerous, minute seeds blown across the jungle may here and there find a suitable spot for growth, and so carry on the spread of the plant, though in these forests far the greater number of seeds must perish for want of a suitable growing spot.' According to CORNER, *l.c.* one of the characteristic trees of all the passes of the Main Range in the Mal. Peninsula from G. Angsi to Kroh.

*Uses.* Wood used for tea-boxes and for house- and boat-building. Malays eat the very acid fruits (BURK. *l.c.*).

*Vern.* Malay Peninsula: *Pédada*, *p. bukit*, *p. darat*, *këndada*, *këndada bukit*, *běřmbang bukit*, *b. darat*, *běřmah* (Kroh), *běřombong bukit*. As *bukit* means hill or mountain, the Malays apparently observe acutely the affinity of *Sonneratia* and *Duabanga* as *pedada* is the universally used name for the former, and the names can thus be translated: inland-*Sonneratia*.

*Notes.* The flowers emit an offensive smell.

#### Excluded

*Xenodendron* LAUT. & K. SCH. Fl. Deut. Sch. Geb. Südsee (1901) 461; E. & P. Nachtr. 3 (1908) 239, f. 33 = *Acmena* (Myrt.), cf. MERR. & PERRY, J. Arn. Arb. 19 (1938) 11.

## DIPSACACEAE<sup>1</sup> (C. G. G. J. van Steenis, Leyden)

### 1. TRIPLOSTEGIA

WALL. in DC. Prod. 4 (1830) 642; in DC. Coll. Mém. 7, Valér. (1832) 19, t. 5.—*Hoeckia* ENGL. & GRAEBN. Bot. Jahrb. 29 (1901) 598.—Fig. 1.

Erect, perennial herbs; rootstock horizontal; stem-base (? always) provided with 2 elongated, spindle-shaped, subterranean tubers. *Leaves* decussate, dentate to pinnatifid, exstipulate, mostly crowded into a basal pseudo-rosette, cauline ones distant, gradually reduced; base decurrent into the petiole; petioles clasping the stem. Panicle terminal, bracteate, branches decussate, forked, cymose, outermost in triads; rachis and branches distinct from the stem by the presence of capitate-glandular hairs. *Flowers* ♀, articulated on a short pedicel, 5-merous, subactinomorphic. Base of the pedicel sustained by 2 narrow, ciliate, 1-nerved bracts ending in a thickened (? glandular), blunt nerve-tip. Ovary surrounded by 4 conspicuously capitate-glandular, persistent bracts connate at their extreme base and cuspidulate (in fruit hooked) at their apex (*outer epicalyx*) and a tubular, 8-ribbed, utricle-shaped, persistent *inner epicalyx* with a slight constriction at its apex below a minute, crenulate or toothed limb. Calyx minute, epigynous, 5-lobed. Corolla epigynous, gamophyllous, white, pink or red, caducous; tube funnel-shaped; lobes 5, equal, rounded, erect, imbricate in bud. Stamens 4, equal, alternating with the lobes; filaments free towards the apex of the tube; anthers introrse, dorsifixed. Style 1, terete, stigma capitate. Ovary 1-celled, narrow. Ovule 1, pendulous from the apex of the cell to halfway the ovary. *Fruit* 1-seeded, thin-walled, surrounded by the inner epicalyx, and this in turn by the hardened, 4-lobed, capitate-glandular outer epicalyx, the tips of which are hooked; fruit with epicalyces breaking off from the top of the pedicel as a diaspore. *Seed* oblong, subterete, acutish towards both ends, smooth but for two faint, longitudinal ridges; albumen plentiful; embryo scarcely shorter than the seed.

Distr. Two spp., from the Sikkim-Himalaya, S. China and Formosa, to *E. Malaysia*.

Ecol. A decidedly microtherm genus with a most peculiar, apparently undescribed, 'double' adaptation for epizooic dissemination by the (probably sticky) glandular-capitate mucor-like hairs and the hooked tips of the lobes of the outer epicalyx which embrace the fruit and fall off with it from the articulation at the apex of the pedicel. The comparison I made formerly between distribution and dispersal methods in *Valeriana* and *Triplostegia* (cf. Bull. J.B.B. III, 13, p. 257, 403–404) loses much of its value by the detection of the above-described dispersal mechanism. '*Hoeckia*' was reported to smell of valerianic acid.

Anat. Acc. to GAGNEPAIN (Bull. Soc. Bot. Fr. 47, 1900, 333) the pollen resembles that of *Scabiosa*.

Notes. *Dipsacaceae* contain about 10 genera, all native to Europe and Asia, with some outliers in N. Africa & Ceylon; *Triplostegia* in Celebes and N. Guinea represents the single record on the S. hemisphere. The *Dipsacaceae* are undoubtedly allied to the *Valerianaceae*, which are distinct by their typically 3-celled ovary and absence of an epicalyx. ENGLER & GRAEBNER in describing the genus *Hoeckia* from China, assumed to have found a missing link between the two families in ascribing to *Hoeckia* a single epicalyx and a 3-celled ovary with 2 abortive cells. However, they clearly erred in the interpretation of the floral parts of *Hoeckia* and mistook the inner ribbed epicalyx for the pericarp. There is no doubt that *Hoeckia* is a true *Triplostegia*; it is clearly identical with *T. glandulifera* WALL., which I find confirmed by HANDEL-MAZZETTI (Symb. Sin. 7, 4, 1936, 1055).

Leaf-size and shape are, in *Triplostegia*, very variable and not fit for specific distinction. There is, also, variation in the subterranean parts dependent on habitat.

Three *Triplostegias* have been erratically described by LÉVEILLÉ (Bull. Géogr. Bot. 24, 1914, 282; *ibid.* 25, 1915, 13) which do not belong to the *Dipsacaceae*. According to the types kindly put at my disposal by Sir WILLIAM WRIGHT SMITH they represent:

*T. epilobifolia* LÉV. = *Inula* cf. *exsuccata* LÉV. (det. Miss J. KOSTER).

(1) According to BAKHUIZEN VAN DEN BRINK Jr (in BACKER, Bekn. Fl. Java, em. ed. 8, 1949, fam. 177, p. 1) *Scabiosa atropurpurea* L., an annual from the E. Mediterranean, is sometimes cultivated as an ornamental in gardens in the mountains of Java.

*T. mairei* LÉV. = *Chrysosplenium henryi* FRANCH.

*T. pinifolia* LÉV. = *Sedum asiaticum* DC.

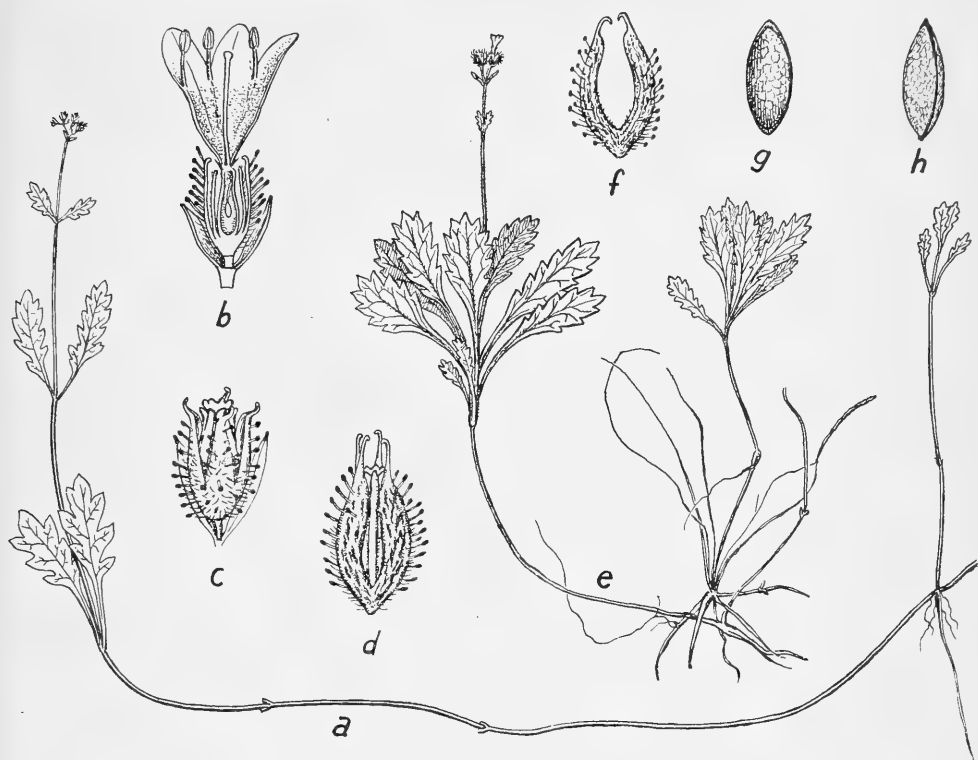


Fig. 1. *Triplostegia glandulifera* WALL. a. Habit (of type of *T. repens* HEMSLE.), b. schematic section of a flower (after HÖCK, 1891), c. flower without corolla, on pedicel with two bracts (from type of *T. repens*), d. diaspore (WILSON 3776), e. habit of fresh New Guinean material (BRASS 9208), f. section of outer epicalyx in fruit (WILSON 3776), g-h. seed (from ditto). (a & e nat. size, others enlarged).

1. *Triplostegia glandulifera* WALL. in DC. Prod. 4 (1830) 642; DC. Coll. Mém. 7, Valér. (1832) 19, t. 5 (*T. glandulosa*); HOOK. f. Fl. Br. Ind. 3 (1881) 215; SASAKI, Cat. Govt Herb. Formosa (1930) 488.—*Hoeckia aschersoniana* ENGL. & GRAEBN. Bot. Jahrb. 29 (1901) 598.—*T. repens* HEMSLE. Kew Bull. (1899) 101; DIELS, Bot. Jahrb. 62 (1929) 493; STEEN. Bull. J.B.B. III, 13 (1934) 257; MERR. & PERRY, J. Arn. Arb. 30 (1949) 55.—Fig. 1.

Fragile, 5–15 cm long, erect, mostly with a distinct rosette at the base of the stem or higher on the stem, above a creeping branched rootstock. Cauline leaves reduced, 1–2 pairs. Leaves spatulate to oblong-obovate, coarsely dentate or sub-pinnatifid in the upper portion, basal part entire, tapering into a distinct or indistinct petiole, 1–3 cm long, upper surface puberulous towards the margins, lower surface with scattered hairs on midrib and nerves. Inflorescence few-flowered and congested, stalks expanding in fruit. Bracts linear-spatulate, puberulous, margins ciliate,  $2\frac{1}{2}$ –3 mm. Flowers white. Pedicels very short, in fruit to 1 mm. Lobes of outer epicalyx narrow-triangular, short-pubescent and capitate-glandular,  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm,

the acute tip mucronate, hardening and hooked in fruit, slightly exceeding the calyx. Inner epicalyx pubescent on the ribs,  $1\frac{1}{2}$  mm long; limb consisting of 8 minute triangular teeth. Calyx cup-shaped,  $\pm \frac{1}{4}$  mm long, 5-lobed halfway down, lobes broad-triangular acute. Corolla 3–4 mm long, tube funnel-shaped, twice as long as the broadly elliptic, rounded, obliquely erect lobes; one vein in each lobe. Filaments erect, inserted just below the incisions,  $\frac{1}{2}$  mm long; anthers exserting from the tube. Style 2 mm long, straight; stigma capitate.

Distr. NW. India, Sikkim, Yunnan, E. Tibet, Szechuan, and Formosa, in Malaysia: Central Celebes (summit of Mt Kambuno) and New Guinea, 2000–3300 m, expected to occur also in Luzon and Ceram.

Ecol. Fl. March–August.

Notes. From a mixture of some mountain herbs collected by the late Dr P. J. EYMA in Central Celebes, 1937, I segregated one tiny, unintentionally collected specimen, which I assumed to be identical with the New Guinean specimens on the strength of the original, inadequate description and a crude drawing of the type I had made at Kew in

1934. This remarkable find, forming a transition station between Formosa and New Guinea, was, unfortunately, apparently lost after the war.

I can find no adequate specific characters for distinguishing the Papuan specimens from the continental Asiatic ones. They are all dwarfy, but dwarf specimens are also known from Yunnan. The Asiatic specimens attain mostly a length of

20–50 cm. According to MERRILL & PERRY the substratum is to be held responsible for the place on the stem (rootstock) where the basal rosette develops.

The closely allied *T. grandiflora* GAGN. (*syn. T. delavayi* FRANCH. *ex* DIELS), from Yunnan, can easily be distinguished by a tubular, 7–10 mm long corolla.

## DIOSCOREACEAE<sup>1</sup> (I. H. Burkill, Leatherhead, Surrey)

Rhizomes (rarely spiny) producing annual, mostly twining shoots, in Malaysia twining either to the right (fig. 4c) or the left (fig. 4a). Stems consisting of a main stem and sterile branches, both bearing leafless flowering axes. *Leaves* petiolate, generally cordate, simple and entire or palmately lobed, or palmately compound, except in the latter triplinerved; apex generally glandular, developed before the blade (forerunner tip); blade usually glandular on the lower side chiefly towards the base. *Flowers* hermaphrodite or dioecious, ♀ with staminodes, ♂ without even a rudimentary ovary, actinomorphic, 3-merous, mostly inconspicuous and greenish, ♂ often massed together and scented. *Tepals* in two whorls of 3. Stamens in 2 whorls of 3, the inner sometimes sterile; anthers usually introrse. Torus an urceolate, perianthoid chamber in *Stenomeris*, a saucer or cup in many *spp.* of *Dioscorea*, fleshy in *Dioscorea* § *Enantiophyllum*, in some *spp.* enlarged into a cone making the stamens appear to be connate. Style 1 with 3 bifid stigmas. *Ovary* 3-locular, inferior, sometimes separated from the perianth by a constriction. *Ovules* 2 in each cell or ∞ (in *Stenomeris*), anatropous. *Fruit* a capsule, but it breaks up rather than dehisces in *Trichopus*. Seeds winged or wingless (in *Trichopus*); endosperm horny, embryo in a marginal pocket.

*Distr.* Ca 9 genera and about 600 *spp.* (*Dioscorea* large, the other genera small or monotypic). Pantropic with considerable extensions into temperate regions. The *Stenomerideae* and *Trichopodeae* are restricted to the warm humid regions where *Nepenthes* grows and their geologic history must have been that of *Nepenthes*: they may be regarded as the survivors of the hermaphrodite ancestry of the *Dioscoreae*.

*Ecol.* The base of the stem is modified for storage of food and water in various ways by conversion into a thickened rhizome or a swollen vertical body of fixed position in the soil or most commonly into a short cormous body with tuberous outgrowths of annual duration. The storage organs are protected against herbivorous animals either by the overlying soil or by poisonous substances, or in a few species by a corky covering, or in a very few species by thorny roots.

The annual stems do not twine from their base, but commence to twine at a little distance above the soil, and do so consistently either to the right (fig. 4c) or to the left (fig. 4a). Departure from this rule has been observed in none but a single African species; and there are dwarf species among which is *Trichopus zeylanicus* (see p. 297) which do not attain sufficient height for twining. The direction of twining is an important taxonomic character.

The cauline axes are differentiated above ground in various degrees of completeness into (i) the main stem, (ii) branches arising from it, indued with fertility, not themselves carrying flowers, but carrying (iii) leafless axes which bear the flowers. Flowering commences as a rule well above the commencement of twining, and at the level where it begins, there is usually a diminution in the size of the leaf blades such as causes the leaves most useful taxonomically to be immediately below the horizon at which the flowers commence.

The cordation of the leaf characteristic of the family is completed in the last stages of its enlargement; and leaves that are hindered, say, by want of building material, from growing to their maximum, such leaves as occur towards the distal ends of stems, are less cordate than more favoured leaves. The leaves of seedlings at an age when the plants are few-leaved, are much larger at the base than leaves borne later in association with flowers (fig. 10).

The flowers are entomophilous. In the hermaphrodite flowers of the *Stenomerideae* and *Trichopodeae* there are elaborate arrangements to secure cross-fertilization which is inevitable in the dioecious *Dioscoreae*.

Sometimes 3 of the stamens, invariably the inner 3, are staminodal, and they are then as a rule modified, compelling visiting insects to move in such a way as to pick up pollen.

The flowers are inconspicuous except in the Madagascan genus *Avetra* (*Trichopodeae*), and of moderate

(1) This treatment of the *Dioscoreaceae*, more profuse than the general plan of this Flora, is justified by their economic importance, and above all by their difficulty. The specific delimitation accepted here is narrower than that adopted by some other authors; the present writer based his views on an exceptionally extensive and detailed knowledge of Malaysian *Dioscoreaceae* during many years of study of fresh materials. The separation of the sexes demands keys for each sex and such have been provided where the material made this possible; keys based entirely on vegetative characters proved to be ineffective.—*Ed.*

size but inconspicuous coloration in *Stenomeris*; or in *Dioscorea* they are green and small or very small; but they are often scented and the male flowers are massed together.

There is a greater abundance of male plants and a much greater abundance of flowers on male plants.<sup>1</sup>

The outer tepals usually are a little larger than the inner ones and cover them in the bud. Among the *Dioscoreaceae* of Malaysia, sterilization of stamens in the ♂ flowers is found in none but species of sect. *Lasiophyton*; sterilization occurs in two other Malaysian sections but not in species found in Malaysia.

The cells of the ovary enlarge so as to provide in advance space for the wings on the seeds which remain small until just before ripeness. The position of the ovules on the placenta, whether near the apex or the base or at the middle is bound up with the direction in which the wings grow. The act of pollination induces growth under the capsule and this growth is used through geotropism to determine the poise of the capsule.

Anat. There is a tendency throughout the family to have longitudinal ridges on the stems; sometimes they are inconspicuous, sometimes raised into ridges or wings, and they invariably overlie the vascular bundles that descend from the petiole; their number in each internode depends on the arrangement of the leaves.

Anatomical studies enabled QUEVA to state (Mém. Soc. Sc. Lille IV, 20, 1894, 42) that *Stenomeris* and *Trichopus* agree with *Dioscorea* in internal structure. Fig. 6 shows the shape of the epidermal hairs; they possess a taxonomic value and so also does the nature of the glandular fore-runner tip (see ORR, Notes R. Bot. Gard. Edinburgh 14 no 68, 1923, and 15 no 73, 1926).

Glands are of two kinds (i) spherical or lenticular superficial groups of cells, chiefly on the backs of the laminae but also on stems and petioles, and (ii) larger, often lobed, agglomerations of excretive cells with a pore to the surface. ORR found no case of the two occurring in association in any of the species which he was able to examine.

Notes. There is controversy about the rank of *Stenomerideae* and *Trichopodeae*: should they be raised to the rank of families, *Stenomeridaceae* and *Trichopodaceae*, as HUTCHINSON suggests (Fam. Fl. Pl. 1934, 141), or retained as tribes? The latter is preferable because the former obscures the epigenesis of the *Dioscoreeae*. The botanists who first examined *Stenomeris* and *Trichopus* were puzzled by them. GAERTNER (1788) saw a resemblance of *Trichopus* to *Commelina*: LINDLEY (1832) referred it to *Aristolochiaceae*, seeing a similarity between it and *Asarum*; but KLOTZSCH (1859) suggested *Dioscoreaceae*.

PLANCHON (1852) put *Stenomeris* into the *Burmanniaceae* because the flower is similar in shape to the only *Thismia* then known. BECCARI brought it (1870) into the *Dioscoreaceae* and agreed with KLOTZSCH as to the position of *Trichopus*.

Today the genera are well established; but much information is needed before the interrelations of the sections of *Dioscorea* are understood. The sequence adopted here, namely *Stenomeris*–*Trichopus*–*Dioscorea* commencing with the section *Stenophora*, is employed as epigenetic: hermaphroditism is held to have preceded dioecism; unlimited seed production to have been the rule before limitation to six ovules in an ovary and enlargement of the base of the stem into a rhizome to have existed before the development of the compound tuber-bearing corm. In this sequence the units in which the forerunner tip is little developed find an early place and so also do those that do not have complex hairs. In the present treatment our monograph of *Dioscorea* (cf. Ann. R. Bot. Gard. Calc. 14, 1936 & 1938) is mostly followed.

#### KEY TO THE GENERA

1. Flowers hermaphrodite.
2. Fruit a capsule with numerous winged seeds. Torus developed into a perianthoid chamber, wherein the sexual organs are completely enclosed (*Stenomerideae*) . . . . . 1. *Stenomeris*
2. Fruit breaking up rather than dehiscent. Ovules 2 in each cell. Seeds wingless. Torus flat (*Trichopodeae*) . . . . . 2. *Trichopus*
1. Sexes in separate plants. Fruit a capsule with winged seeds in each cell (*Dioscoreeae*) 3. *Dioscorea*

#### 1. STENOMERIS

PLANCH. Mém. Sc. Nat. III, 19 (1852) 320; BECCARI, Nuovo Giorn. Bot. Ital. 2 (1870) 8; TAUBERT, Bot. Jahrb. 15, Beibl. 38 (1892) 1; R. KNUTH, Pfl. R. 87 (1924) 344.—*Halloschulzia* O. KUNTZE, Rev. Gen. Pl. 1 (1891) 705.—Fig. 1.

Underground a short rhizome. Stem tough, unarmed, twining to the left, with loosely paniculate flowering branches. Leaves entire, cordate at their largest, but distally gradually losing their auricles until the base of the lamina is obtuse or even acute, herbaceous, drying, as does the whole plant, a dark brownish purple. Flowers hermaphrodite; torus developed into a perianthoid urceolate chamber which en-

(1) A similar distribution of sexes has been found in other plants with corms, cf. Bull. Bot. Gard. Btzg III, 17 (1948) 449.

closes entirely the sexual organs and carries marginally the 6 tepals. *Stamens* 6, inserted just within the mouth of the chamber by rather stout, flattened, deflexed filaments which bring the anthers parallel to the chamberwall with their introrse anther-cells dehiscing towards the wall; beyond the anther-cells the connective is prolonged as a slender process which reaching the apex of the columnar style may adhere there and seems usually to do so, but the manner is not yet known.<sup>1</sup> Style rising into the perianthoid chamber from the base, columnar, ending in three bifid stigmas. *Ovary* widening upwards to make the floor of the chamber, 3-locular with numerous ovules. *Fruit* a triangular capsule, dehiscent along its whole length at the angles. Seeds developing a wing forwards and outwards, the body of the seed flat, triangular, and widened from its insertion to its wing.

Distr. *Malaysia*, almost entirely N of the equator. Species 2, intimately allied.

Ecol. Everwet, humid, lowland forests.

Note. TAUBERT's sections *Hematanthera* and *Mystranthera* appear untenable, cf. discussion under *S. dioscoreifolia*.

#### KEY TO THE SPECIES

1. Panicle long and directed downwards, the flowers on it more or less facing earthwards. Tepals 6–15 mm long, slender above the base . . . . . 1. *S. dioscoreifolia*
1. Panicle relative small, usually exceeded by the axillant leaf. Tepals to 5 mm long, maintaining an even breadth from the base upwards almost to a rounded or obtuse apex . . . . . 2. *S. borneensis*

1. *S. dioscoreifolia* PLANCH. Mém. Sc. Nat. III, 19 (1852) 320; WALP. Ann. 6 (1861) 211; BECCARI, l.c.; SCHEFF. Nat. Tijds. Ned. Ind. 34 (1874) 70; VIDAL, Phan. Cum. Philip. (1885) 153; Rev. Pl. Vasc. Filip. (1886) 276; ROLFE, J. Bot. 23 (1885) 216; MERR. Philip. J. Sc. 2 Bot. (1907) 268; En. Philip. Fl. Pl. 1 (1922) 219; R. KNUTH, Pfl. R. 87 (1924) 344.—*S. cumingiana* BECCARI, Nuovo Giorn. Bot. Ital. 2 (1870) 8; MERR. l.c.; R. KNUTH, l.c.—'Rajania?' NAVES in NAVES & F-VILLAR, Nov. App. (1880) 260.—*S. wallisii* TAUBERT, Bot. Jahrb. 15, Beibl. 38 (1892) 1; R. KNUTH, l.c.—Fig. 1b-k.

Underground parts unknown. Plant glabrous, though perhaps with a minute scurfiness about the inflorescences. Stem smooth. *Leaves* that are below the horizon of flowering large, even to 21 by 19 cm, exactly cordate save for their acumination, and when of this size 13-nerved from the base; petiole about half as long as the blade with the lower pulvinus occasionally much elongated (as in fig. 1); (though such a pulvinus is not prehensile it aids climbing by preventing slipping from supports). Fertile branches sometimes of great length, arching out from the axil and then pendent, sometimes bearing a few small assimilating leaves. *Flowers* cymosely arranged, mostly facing earthwards; pedicels as long as, or longer than the flowers, thin or even capillary. Many flowers are open at the same time, and anthesis is deliberate. *Tepals* during anthesis gradually recurving; tube 3–7 mm deep, persisting in a disorganized state to fruit-ripening; lobes 6–15 mm long, if more than 10 mm long and associated with a tube 4 mm long (or longer: var. *megalanthera* BURK. n. var.), tube slightly contracted at the mouth; lobes growing a little during anthesis, narrowed rapidly at the base by ceasing growth from above downwards. *Stamens* as de-

scribed above. *Ovary* with 9 ridges, 1–2 mm long. *Capsule* at ripeness to 35 cm long or longer, with perhaps 100 seeds, pendent but not always straight, dehiscing along its whole length. Seeds to 7–9 mm long widening evenly from the attachment to 2–3 mm in width and with 6–7 broken lines on each face, included the wings to 2½ cm long, the wings to 1 cm in width, so placed in the capsule that one seed scarcely overlaps another.

Distr. *Malaysia*: Philippines (fig. 3c).

Ecol. *S. dioscoreifolia* occurs only in the most evenly humid parts of the Philippines, which parts are towards the eastern ocean; it grows near streams at low elevations. The progress of anthesis is indicated here by the three drawings fig. 1d-f. Because in anthesis the tepals progressively move away from their early upright position TAUBERT's use of their position to define his *S. wallisii* cannot be justified, nor BECCARI's in defining *S. cumingiana*.

The blades are poised, as is general in the family, with the acumination pointing downwards. *Fl.* May & June, Dec. & Jan.

Notes. It is desirable to justify the reduction of *S. cumingiana*. BECCARI had but two specimens when he assigned the one to *S. dioscoreifolia* and the other to *S. cumingiana*, consequently the variability of the flower was hidden from him: one of the two was an isotype of *S. dioscoreifolia*, the other a unique *no* 1739 which the writer has seen but owing to the paucity of the material he is obliged to accept the internal structure of its flower from BECCARI without verification. BECCARI enumerated four differentiating characters: he stated that (i) the prolongations of the connective which unite with the style in *S. dioscoreifolia*, fail to do so in *S. cumingiana*; (ii) the leaves are 7–9-

(1) BECCARI suggested, that there is a nectary at the apex.



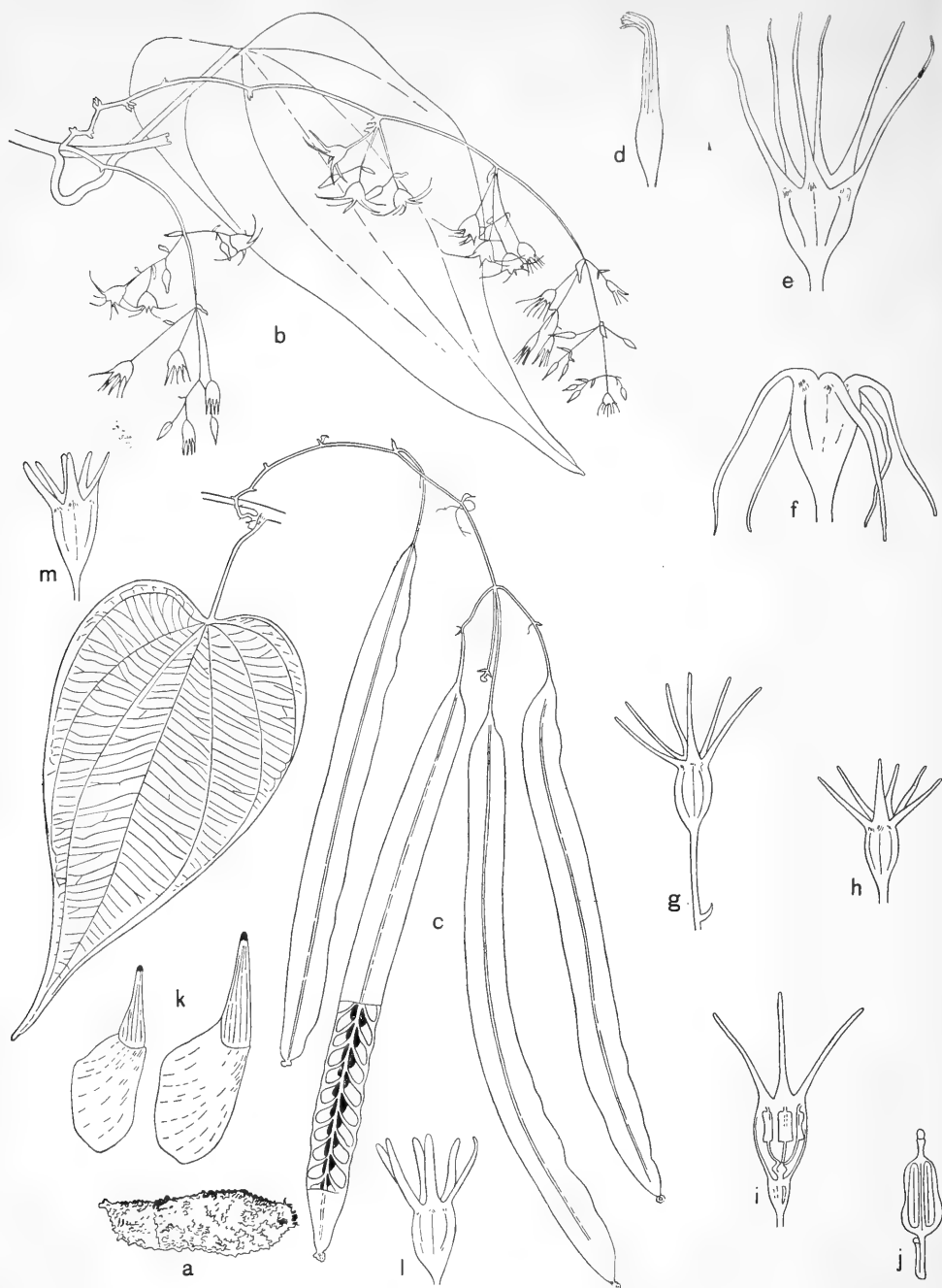


Fig. 1. *Stenomeris*.—a. Rhizome,  $\times 2/5$ .—*St. dioscoreifolia* PLANCH.: b. inflorescence of var. *megalanthera* BURK.,  $\times 4/5$ , c. infructescence with part of valve removed to expose seeds,  $\times 2/5$ , d–f. three stages in the anthesis of var. *megalanthera* BURK.,  $\times 2$ , g–h. flowers as of the type,  $\times 2$ , i. vertical section through flower showing downwardly bent stamens and their prolongations which reach the style,  $\times 2$ , j. a stamen from the face turned downwards the chamber wall, k. seeds,  $\times 2$ .—*St. borneensis* OLIV.: l. flower from type specimen showing its blunt tepals,  $\times 2$ , m. flower from isotype of *St. mindanaensis* KNUTH,  $\times 2$ .

nerved and gradually acuminate in the first but 13-nerved and abruptly acuminate in the second; (iii) the throat which is 'constricted and strengthened by a somewhat outstanding ring' in the first is 'scarcely constricted' in the second, and (iv) the perianth lobes which are erect and then recurved in the first, are 'erect to spreading and bent inwards at the apex' in the second.

Material now available shows that characters ii, iii, and iv make an unbroken series throughout, then, as to the first character, seeing that the adhesion is a secondary phenomenon in the development of the flower, failure to achieve adhesion would seem to be merely an accident. On reducing *S. cumingiana* TAUBERT's sections of the genus, *Nematanthera* and *Mystranthera* fall. CUMING preserved two inflorescences, one only 4 cm long, the other 10 cm, apparently belonging to a plant of weak growth.

2. *S. borneensis* OLIV. in HOOK. Ic. Pl. 4 (1894) t. 2328; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 85; RIDL. & WINKLER, Bot. Jahrb. 44 (1910) 529; MERR. En. Born. (1921) 119; RIDL. Fl. Mal. Pen. 4 (1924) 313;

R. KNUTH, Pfl. R. 87 (1924) 328.—*S. mindanaensis* R. KNUTH, l.c.—Fig. 1 l-m.

Underground a short horizontal rhizome with an uneven surface, scars of a few more or less amplexicaul scale-leaves and white flesh. Plant glabrous except for a minute scurf on the inflorescences. Stems climbing to 5 m, faintly ridged at the base where they are 2–3 mm in diam.: ridges 3 from each leaf-base. A few scale-leaves are produced before the first assimilating leaves. Lower leaves to 25 by 18 cm, the largest 11-nerved, in appearance exactly as those of *S. dioscoreifolia*. Panicles smaller than in that species but otherwise similar. Flowers with shorter and broader perianth lobes; the lobes usually to 4 mm in length, rounded at the apex in specimens from Borneo, bluntly pointed in specimens from Mindanao (var. *mindanaensis* R. KNUTH); the rest of the flower as in *S. dioscoreifolia*, capsule perhaps shorter.

Distr. Malaysia: Sumatra (East Coast), Mal. Peninsula, Borneo, Philippines (Mindanao). Fig. 3b.

Ecol. Preferably on wet soil. Fl. Sumatra: April–May, Sarawak: March & Oct., Mindanao: Oct.

## 2. TRICHOPUS

GAERTN. Fruct. (1788) 44, t. 14; BECCARI, Nuovo Giorn. Bot. Ital. 2 (1870) 13; BENTH. in B. & H. Gen. Pl. 3 (1883) 745; PAX in E. & P. 2, 5 (1888) 136; ULINE, Bot. Jahrb. 25 (1898) 155; TRIMEN, Handb. Fl. Ceylon 4 (1898) 279; R. KNUTH, Pfl. R. 87 (1924) 347; in E. & P. ed. 2, 15a (1930) 461.—*Trichopodium* LINDL. Bot. Reg. (1832) sub t. 1543; ENDL. Gen. Pl. 1 (1837) no 2165.—*Steireya* RAFINESQUE, Fl. Tell. 4 (1836) 100.—*Podianthus* SCHNIZLEIN, Bot. Zeit. 1 (1843) 739.—Fig. 2.

Glabrous, preserving through life the habit of the first-year seedling of *Dioscorea*, which lies in the arrest of the second leaf of a stem to the advantage of the first. In the surface soil a rather dry, 1–4 cm long rhizome with occasional branching, ascending slightly at the apex and dying behind, losing its scale-like leaves before death, coated with chaffy very acute scale-leaves up to 5 mm long. Stems 5–7 (–20), erect or ascending, to 12 cm below the solitary leaf, with c. 7 low ridges. Fertile branch with distichous scale-leaves similar to those on the rhizome but shorter, with flower buds in their axils, the whole looking like a spikelet of *Bromus*. Flowers extruded from between the protecting scale-leaves one at a time until 1 or 2 are pollinated whereupon those following are arrested. Leaf (in Malaysia) always cordate-sagittate, 10 by 4 cm, primary nerves 5–7, 3 reaching the blunt apex, the outer being in the margin. Blade shortly acuminate below the apex; margin undulate; petiole usurping the line of the stem by pushing the fertile branch to one side, vertical (in Malaysia). Pedicels to 7 cm long, nodding, dull purple with a greenish colour towards the base. Tepals (in Malaysia) to 1 cm long. Stamens 6, anthers raised on short zigzag filaments widening into broad connectives with the anthers edge to edge and making a roof over a chamber into which pollinating insects should enter; beyond the anthers the filament is prolonged into a process which projects forwards between the stigmas. Style stout. Fruit 3-winged, wings thick instead of flat as in *Dioscorea*, to 13 by 6 mm, somewhat trapezoid by reason of the way in which they narrow towards the apex and the base of the fruit, broadest



Fig. 2. *Trichopus zeylanicus* GAERTN. ssp. *travancoricus* (BEDD.) BURK. a. fruiting plant,  $\times \frac{2}{3}$ , b. rhizome branching (near arrow),  $\times \frac{2}{3}$ , c. two inflorescences,  $\times 7$ , d. flower showing its poise,  $\times 2$ , e. outer tepal,  $\times 2$ , f. stamen seen from outer side,  $\times 20$ , g. section through flower indicating how the prolonged connective passes between the stigmatic arms, h. two sides of a seed, showing the difference in sculpture,  $\times 3$ .

above mid-length. *Seeds* upwards of 6 freed by the fruit walls breaking irregularly, wingless, flat, more so on one side than on the other, and differently invaginated.

Distr. Monotypic, Ceylon and Southern India, in *Malaysia*: Malay Peninsula. The area is remarkably similar to that of the dilleniaceous genus *Acrotrema*.

1. *T. zeylanicus* GAERTN. Fruct. 1 (1788) 44, t. 14; THWAITES, En. Pl. Zeyl. (1861) 291; BECCARI *l.c.*; BEDDOME, Ic. Pl. Ind. Or. (1874) t. 290, but not quite accurate; HOOK. f. Bot. Mag. (1894) t. 7350; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 79.—*Trichopodium cordatum*, *T. intermedium* & *T. angustifolium* LINDL. Bot. Reg. (1832) sub t. 1543.—*Podianthus arifolius* SCHNIZLEIN, Bot. Zeit. 1 (1843) 739.—*Trichopodium zeylanicum* THWAITES, *l.c.*—*Trichopodium travancoricum* BEDDOME, *l.c.*—*Trichopus malayanus* RIDL. Fl. Mal. Pen. 4 (1924) 312, with a slightly inaccurate figure.—Fig. 2.

Characters as of the genus.

Distr. Ceylon, S. India, and *Malaysia*: Malay Peninsula (Kelantan, where the rivers Lebir and Galas unite, and Pahang, at a place near the Pahang River, about 300 km further south). Fig. 3a.

Ecol. In Ceylon it grows in lowland sandy forest near streams and in the Malay Peninsula in lowlying forest. In these places it is liable to be flooded; but that similar conditions rule where it grows (at about 1000 m alt.) in S. India is not known.

In Ceylon and the Malay Peninsula the dispersal of the seeds is undoubtedly by sudden floods which break the fruit from its slender peduncle and carry it away. The upright position of the leaf blades as seen in *Malaya* is doubtless a reaching out for light from above, for when the plant was grown in a glass house at Kew, their poise was less upright (see Bot. Mag. t. 7350); moreover, herbarium specimens from Ceylon show that the poise may differ. It is not known if the flower is scented.

Notes. The Malayan plant agrees exactly with that of Travancore (*Trichopodium travancoricum*

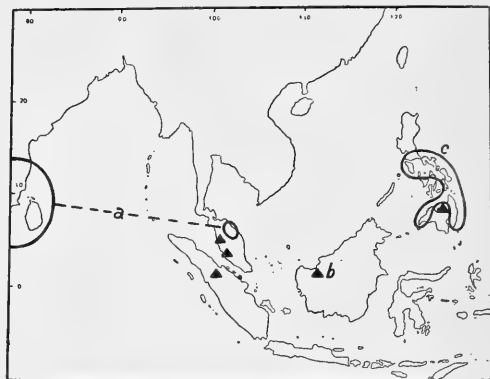


Fig. 3. Geographical distribution of a. *Trichopus*, b. (▲) *Stenomeris borneensis* OLIV., c. *Stenomeris dioscoreifolia* PLANCH.

BEDD.). The Ceylon plant undoubtedly differs by deltoid or even linear-lanceolate, erect leaves and tepals 3 mm long, but THWAITES held the Travancore plant to be conspecific with the Ceylon plant and would therefore have regarded the Malaysian as conspecific also. If consent be given to that view, this distinguishing name is required for the Indian-Malaysian plant: *Trichopus zeylanicus* ssp. *travancoricus* (BEDD.) BURK. *stat. nov.*

The subspecies is then to be defined on the size of the flowers. It may be commented that the Ceylon plant possesses a variability which is absent from the Indo-Malaysian subspecies.

### 3. DIOSCOREA

LINNÉ, Sp.Fl. (1753) 1032; KUNTH, En. Pl. 5 (1850) 325; R. A. SALISBURY, Gen. Pl. Fragm. ed. GRAY (1866) 12; BENTH. in B. & H. Gen. Pl. 3 (1883) 742; PAX in E. & P. 2, 5 (1887) 133; ULINE in E. & P. Nachtrag zu II-IV (1897) 80; R. KNUTH, Pfl. R. 87 (1924) & in E. & P. ed. 2, 15a (1930) 438; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936 & 1938).—*Helmia* KUNTH, *l.c.*—*Polynome*, *Hamatris*, *Strophis* and *Elephantodon* R. A. SALISBURY, *l.c.*—*Peripetasma* RIDL. J. Bot. 58 (1922) 147.—Fig. 4-13.

Underground in a few spp. a rhizome, in more spp. a firm, often woody corm which gives off well defined parenchymatous tubers and replaces them annually; as a rule these tubers are buried at the ends of long stalks, but in some species they are without stalks and may be regarded as not more than lobes of the corm; in 2 (perhaps 4-5) species of *Malaysia* spiny roots are produced. Stems in all the Malaysian species twining, some very tall; often woody at the base and armed, always tough; the direction of twining—to the right (fig. 4c) or to the left (fig. 4a)—is characteristic of whole sections. Axillary buds often more than one in an axil and

then in vertical column with the youngest lowest. *Leaves* more frequently alternate than opposite; when both conditions are associated, they are alternate on thin axes becoming opposite as the plant strengthens, simple or palmately compound (§

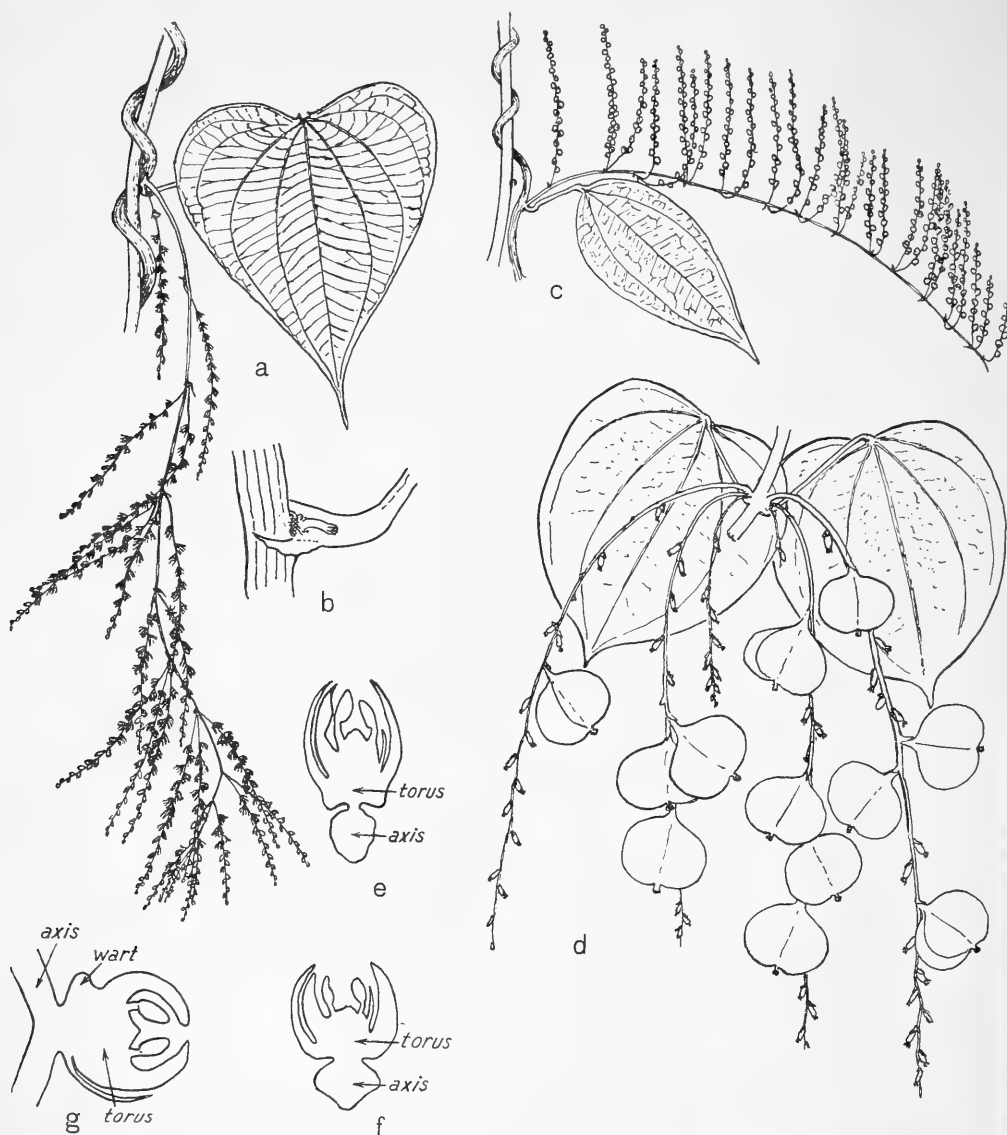


Fig. 4. a. *Dioscorea bulbifera* L. showing a stem which twines to the left, a leaf with its characteristic ladder-like secondary venation, and a male inflorescence,  $\times \frac{1}{2}$ , b. the large petiolar auricle of *D. bulbifera* L., c. *D. laurifolia* WALL. ex HOOK. f. showing a stem which twines to the right, the interruption of the secondary nerves as they cross from midrib to primary nerve, and the male inflorescence which in this species has strongly developed negative geotropism in the axis of the spikes,  $\times \frac{1}{2}$ , d. *D. pyrifolia* KUNTH, a group of  $\varnothing$  inflorescences showing how they are decurved and showing also, as is common, that fertilization may be intermittent, flowers at one horizon obtaining effective pollination and at another dying infertile doubtless as a consequence of unsuitable weather when they were ripe,  $\times \frac{1}{2}$ , e. vertical section through a flower of *D. sexrimata* BURK. showing the enlarged torus, f. similar section through a flower of *D. luzonensis* SCHAUER, g. section through a flower of *D. filiformis* BL. showing wart at base of flower.

*Lasiophyton*), poised so that the forerunner tip is towards the ground; in compound leaves the nerves in the leaflets are pinnate; in simple leaves the primary nerves are palmate. Petiole with a pulvinus at each end, which adjusts the poise of the blade. *Male flowers* frequently in small cymes racemously arranged along the fertile axes; at the distal end of the axis the cymes reduced to single flowers so that this part is a raceme or, in some sections, a well defined spike. Flowers always small and green, but in *D. bulbifera* tinted at times with rose and the green so diluted that the flower is at times loosely called white, often scented (as benzoin), in more than half of the *spp.* of Malaysia opening but little in anthesis. *Stamens* 6, all fertile or the inner 3 as staminodes (§ *Lasiophyton*). *Female flowers* in spikes or spike-like racemes; pollination stimulates growth under the ovary so that a short pedicel is made which adjusts the position of the capsule (fig. 5); the ♀ flowers rather more widely opened than the male and produced in much smaller numbers, their perianth lobes are as a rule more fleshy. Staminodes very small. Style columnar, stigmas deflexed about its column in all Malaysian species. *Capsules* dehiscing from the apex downwards along the wing-margin and sometimes freeing the margin which, then, looks like a fine wire (fig. 5 k, 5 o). *Seeds* always much flattened, winged from the margin, sometimes from the whole margin, sometimes towards the apex of the cell and sometimes towards the base.

*Distr.* Species about 600, distributed through the tropics and the warm temperate zones of the world, very largely montane, some ascending to considerable heights; none naturally common to the Old and

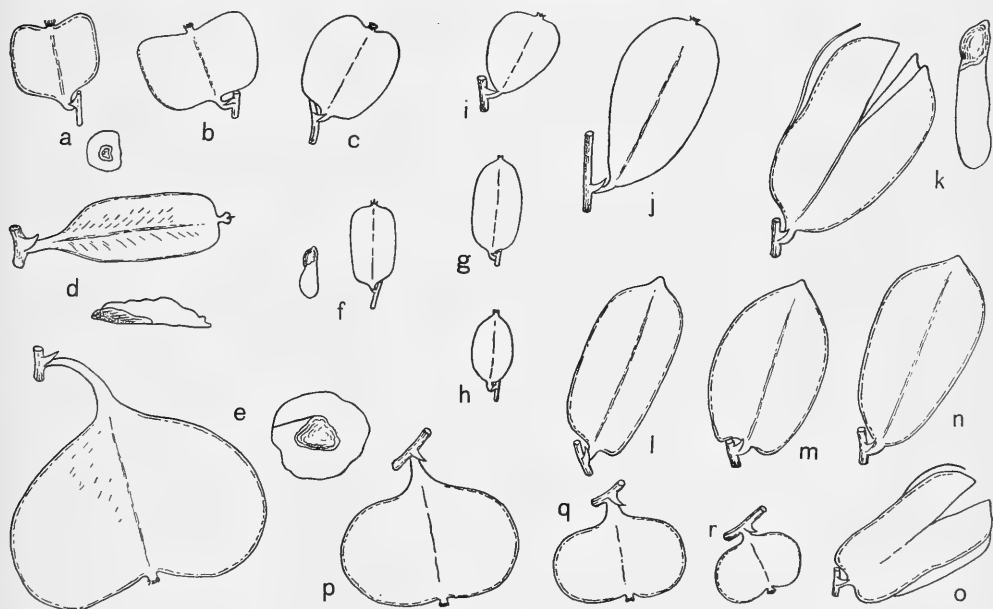


Fig. 5. *Dioscorea* capsules of various species, all  $\times 1/2$ , showing the angle at which they stand when mature. a-b. Capsules and seed of § *Stenophora*: a. *D. prazeri* PR. & B., b. *D. membranacea* PIERRE ex CRAIB. c. Capsule of § *Combilium*: c. *D. esculenta* (LOUR.) BURK.. d. Capsule of § *Paramecocarpa* and its winged seed: d. *D. flabellifolia* PR. & B.. e. Capsule of § *Stenocorea* and its winged seed: e. *D. sumatrana* PR. & B.. f. Capsule of § *Opsophyton* and its winged seed: f. *D. bulbifera* L.. g-o. Capsules of § *Lasiophyton* and its winged seed: g. *D. pentaphylla* L., h. *D. tamarisciflora* PR. & B., i. *D. elmeri* PR. & B., j. *D. cumingii* PR. var. *ramosii* BURK., k-n. *D. hispida* DENNST., o. *D. scortechinii* PR. & B., p-r. Capsules of § *Enantiophyllum*: p. *D. orbiculata* HOOK. f., q. *D. divaricata* BLANCO, r. *D. pubera* BL.

the New Worlds and only one common, without the aid of man, to the continents of Africa and Asia. Many are plentiful where they occur.

Section *Stenophora* has its centre in China whence it extends in the one direction to the Balkans and in the other direction appears in the United States and Canada. The 2 species marking its frontier towards India, enter Malaysia from the north and 2 other little known species, endemics of Malaysia, are attached here to the section.

The sections *Stenocorea* and *Paramecocarpa* are shared by the Indo-Chinese Peninsula and Malaysia.

*Combilium* holds but one species, apparently an entrant into Malaysia from Indo-China, but it may be native of New Guinea as well as Indo-China.

*Opsophyton*, *Lasiophyton* and *Enantiophyllum* are common to Asia and Africa and spread throughout the tropics of both continents. Of sections that penetrate Australia, *Enantiophyllum* extends furthest and then *Opsophyton*; *Lasiophyton* stops at the Torres Straits.

Ecol. It is not known what insects pollinate the flowers, but it is evident that insects do adequate service even when no small distance separates male and female plants from each other. Fig. 4d suggests, that stormy weather may interrupt the activity of whatever the agent may be. The sterilized inner 3 stamens in *Lasiophyton* make baffles in the path of visiting insects: they block the mouth of the flower and cause a visiting insect to touch the pollen-producing anthers. All the Malaysian species of other sections have 6 fertile stamens; though reduction to 3 is met with in two of them, it occurs outside Malaysia.

Uses. The food-value of the yams is great, but some are naturally so poisonous that preparation extended over even as much as seven days is required to make from them a meal that can be eaten. One of the most poisonous is *D. hispida* (see p. 318) which is the chief famine-food of much of the tropical East. *D. esculenta* (see p. 307) and *D. alata* (see p. 330) produce yams that are eaten after a short boiling. *D. alata* is a cultigen of specific rank, and *D. esculenta* var. *fasciculata* a cultigen of varietal rank. Many wild yams from the forests are eaten after prolonged boiling and others after an all-night boiling along with wood-ashes to mitigate their acridity. Among poisonous species an abundance of saponin causes *D. piscatorum* to be used for stupifying fish in rivers, and *D. prazeri* for killing lice in the hair. Many hold tannin enough to make them unsavoury, yet not prevent the needy from eating them. Good or bad, the food-value of every yam lies in the amount of starch that it furnishes; but since the important starchy

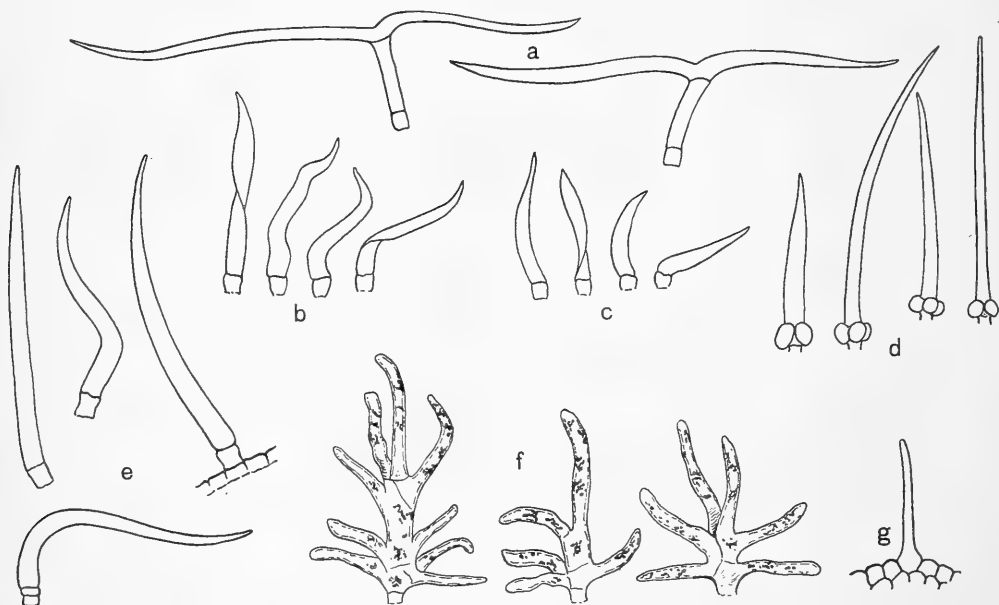


Fig. 6. *Dioscorea* hairs from various species, all drawn to the same scale. a. *D. esculenta* (LOUR.) BURK.: T-shaped hairs with two supporting cells the upper of which varies greatly in length, b. *D. blumei* PR. & B. and c. *D. pentaphylla* L.: 2-celled hairs similar to those of *D. hispida* DENNST. (fig. e) but the cell-walls are thin and the cavity collapses, usually with torsion, d. *D. pyrifolia* KUNTH: stiletto-hairs in which the supporting cell is surrounded by 4 small round cells, e. *D. hispida* DENNST.: rigid hairs consisting of a straight or curved long cell with strong walls raised on an equidimensional cell (or sometimes in its section on 2 such cells), f. *D. orbiculata* HOOK. f.: dendroid hairs, g. *D. caucasica* LIPSKY: one-celled type of hair present in it and other species of § *Stenophora*.

tubers of American origin, Sweet potato, Irish potato and Manioc, were brought into the homes of the yams, all have lost ground to them.

Vern. The uses mentioned above are naturally connected with quite a number of vernaculars; these in turn may give hints on the wanderings of palatable cultigens. As far as they are reliable and important they have been enumerated or discussed under the individual species.

Notes. The genus *Dioscorea* is so closely knit, that to divide it on a higher level than sections is unreasonable; KUNTH's use of *Helmia* as a genus was a convention now out of date, and SALISBURY's divisions the result of inadequate knowledge of *Dioscoreaceae*. Not until 1897 when ULINE proposed divisions based on all the characters, was there any taxonomy likely to persist; and that is not yet stable. It is unfortunate that the underground parts which collectors neglect, furnish a first line character. Second in importance comes the direction of the twining; thirdly the manner in which the seeds are winged and their colour, the shape and the poise of the capsules; fourthly the shape that the torus of the flower takes; fifthly the completeness or incompleteness of segregation of flowers from parts wholly given to photosynthesis; and after that such anatomical features as the hairs exhibit and the glands, etc. Fig. 5 and 6 are inserted to aid the student in regard to characters derived from the capsules and hairs respectively: the capsules are given at the angle at which they stand when mature, which is reflexed in most cases; if directed forward as on the lower line, they then hold seeds winged all round the margin.

The limits of the sections above are not identical with the limits suggested by ULINE and by R. KNUTH. § *Stenophora* ULINE (1897), as recognized here, contains what ULINE put into it and § *Macropoda*, including also KNUTH's (1924) § *Orientali-Asiaticae* and § *Japonicae*. § *Stenocorea* (1914), § *Combilium* (1914) and § *Paramecocarpa* (1924) were created by PRAIN and the author at the dates given: species of the first and last, and perhaps of the second, were unknown to ULINE. § *Opsophyton* ULINE (1897) was greatly and mistakenly enlarged by KNUTH, and is returned to what it was to ULINE. § *Lasiophyton*, § *Botrysicyos* and § *Triumphorostemon* which were created by ULINE (1897) and retained by KNUTH (1924), are united here, but a note regarding the union of § *Triumphorostemon* with § *Lasiophyton* will be found on p. 314 forward where the combined section is discussed. ULINE's § *Stenophyllidium* is inseparable from § *Enantiophyllum*: it contains two Australian species, one of which approaches the Torres Straits so nearly that it should be sought in New Guinea.

#### KEY TO THE SECTIONS (♂ plants)

1. Stems twining to the left (fig. 4a). Flowers usually pedicelled.
2. Leaves simple.
3. Tepals on a broadened torus.
4. Torus saucer- or cup-shaped.
  5. Inflorescence with flowers in cymose groups towards the base e.g. a second flower on the pedicel of the first. *Spp.* 1-4 . . . . . Sect. 1. *Stenophora*, p. 303
  5. Inflorescence a spike or a raceme with solitary flowers.
  6. Hairs absent. *Spp.* 5-8 . . . . . Sect. 2. *Stenocorea*, p. 305
  6. Hairs abundant, T-shaped (fig. 6). *Sp.* 9 . . . . . Sect. 3. *Combilium*, p. 307
4. Torus infundibular. *Spp.* 10-12 . . . . . Sect. 4. *Paramecocarpa*, p. 309
3. Tepals free, on the end of the pedicel. *Sp.* 13 . . . . . Sect. 5. *Opsophyton*, p. 311
2. Leaves compound. *Spp.* 14-21 . . . . . Sect. 6. *Lasiophyton*, p. 313
1. Stems twining to the right (fig. 4c). Flowers invariably sessile. *Spp.* 22-59.
  - Sect. 7. *Enantiophyllum*, p. 320

#### KEY TO THE SECTIONS (♀ plants)

1. Stems twining to the left (fig. 4a).
2. Leaves simple.
3. Capsule as broad or almost as broad as long (fig. 5a-c). Seeds usually winged evenly all round.
4. Hairs, if present, not T-shaped.
  5. Capsules reflexed against the axes of decurved infructescences, their walls as a rule rather thin. *Spp.* 1-4 . . . . . Sect. 1. *Stenophora*, p. 303
  5. Capsules facing earthwards on decurved or more or less horizontal infructescences. *Spp.* 5-8.
    - Sect. 2. *Stenocorea*, p. 305
  4. Hairs plentiful, T-shaped (fig. 6). Capsule reflexed. *Sp.* 9 . . . . . Sect. 3. *Combilium*, p. 307
3. Capsules decidedly longer than broad.
  6. Capsules parallel-sided and horizontal (fig. 5d). *Spp.* 10-12 . . . . . Sect. 4. *Paramecocarpa*, p. 309
  6. Capsules long-elliptic, reflexed on a pendulous infructescence (fig. 5f). *Sp.* 13.
    - Sect. 5. *Opsophyton*, p. 311
2. Leaves compound. *Spp.* 14-21 . . . . . Sect. 6. *Lasiophyton*, p. 313
1. Stems twining to the right (fig. 4c). *Spp.* 22-59 . . . . . Sect. 7. *Enantiophyllum*, p. 320

#### 1. Section *Stenophora*

ULINE in E. & P. Nachtr. (1897) 84; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 19.—Sect. *Eustenophora* (in a subgenus *Stenophora*) R. KNUTH, Pfl. R. 87



(1924) 313.—*Sect. Orientali-Asiaticae* R. KNUTH, *l.c.* 252.—*Sect. Japonicae* R. KNUTH, *l.c.* 254.—**Fig. 5a-b, 6g, 7.**

Underground a rhizome, often short; but there are species in which by report it may be 2 m long. Plant glabrous (in Malaysia), stems twining to the left. Bulbils only produced (rarely) in *D. prazeri*. *Leaves* alternate, simple but not always entire, invariably with large auricles at the base of the lamina making it cordate in varying degree. ♂ *Flowers* in cymes disposed racemously on leafless flowering axes; cymes 2-4-flowered reduced to 1 distally. ♀ *Flowers* on decurved or pendent leafless axes, almost spicate; after fertilization the pedicel reflexes the capsule so that it faces upwards. *Seeds* at maturity of the capsule which dehisces from the upper end downwards winged all round, but not evenly.

*Distr.* Predominantly temperate, reaching the Amur River northwards; absent from the Pacific. Two well-known *spp.* occur widely along its southern frontier towards the Indian Peninsula and *Malaysia*, two others are inadequately known.

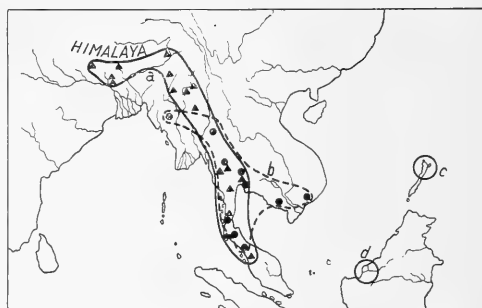
*Note.* Glands have not been found in the forerunner tips of the leaves. About one quarter of the *spp.* carry epidermal hairs, either of a single elongated cell (fig. 6g) or of a filament of cells, 2-3 in number; but the hairy species do not reach *Malaysia*. There are *spp.* with 3 of the stamens in the male flowers sterilized, but again these do not reach *Malaysia*.

#### KEY TO THE SPECIES

1. Male flowers sessile or almost so.
2. Male flowers for the most part solitary; perianth raised by a short tube. Capsule wings  $2\frac{1}{2}$  times as long as wide. Leaves entire, cordate . . . . . **1. *D. prazeri***
2. Male flowers in small cymes; perianth raised by a well developed tube. Capsule wings nearly twice as long as wide. Leaves trifid . . . . . **2. *D. membranacea***
1. Male flowers with conspicuous pedicels, almost without a tube. Capsules unknown **3. *D. palawana***
- Obs.* Male flowers and underground parts unknown. Capsule-wings nearly as wide as long. **4. *D. ridleyi***

**1. *D. prazeri*** PRAIN & BURK. J. As. Soc. Beng. 73 (1904) Suppl. 2; R. KNUTH, Pfl. R. 87 (1924) 175; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 29, pl. 5.—*D. deltoidea* var. *sikkimensis* PRAIN, Beng. Pl. (1903) 1066.—*D. sikkimensis* PRAIN & BURK. J. As. Soc. Beng. *l.c.*—*D. clarkei* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 12.—**Fig. 5a.**

Rhizome branching freely, short and stout, gray-brown or nearly black; flesh white and very poisonous. Stem smooth, ridges very indistinct, climbing to 4 m. *Leaves* cordate or long-cordate, usually to 12 (-20) cm in either dimension, 7-11-nerved; secondary nerves differing a little from the network; both surfaces shining; petiole half as long as the lamina. *Male flowering branches* 1-3 together, from upper leaf-axils or sometimes collected on branches with reduced leaves, cymes 1-3 mm apart; the axis between the cymes apt to be flexuous; narrow wings descend from the bracts; bracts broadly ovate and abruptly long acuminate. Perianth-cup less than 1 mm deep. Tepals  $1\frac{1}{2}$  mm long, ovate and almost rounded above. Anthers turned outwards, much shorter than their filaments. *Female flowering axes* solitary, directed downwards, with about 20 flowers and to 30 cm long. Tepals shorter and thicker than those of the male flower, only just united at the base. *Capsules*, though rarely more than 8 mature, near enough to each other to imbricate, becoming a satiny chestnut brown; wings broadly semi-obcordate or subrhomboidal, rarely semicircular, the base of the capsule obtuse as it passes into the short curved stipe and



**Fig. 7.** Distribution of the species of § *Stenophora* which enter or are endemic in *Malaysia*: a. (A) *D. prazeri* PR. & B., b. (B) *D. membranacea* PIERRE ex PR. & B., c. *D. palawana* PR. & B., d. *D. ridleyi* PR. & B.

the apex cordate with shoulders (fig. 5a). Seeds ovate-oblong, to 12 by 8 mm, reddish at maturity but the wing pale.

*Distr.* From the eastern Himalaya and the mountains between Assam and Burma where it is abundant, southwards through the Shan Hills to the Isthmus of Kra, in *Malaysia*: forward to the northern edge of the Malay Peninsula (Perlis). **Fig. 7a.**

*Ecol.* At its southern limits it grows on limestone. It ascends the mountains of NW. India from near sea-level to 1600 m. It approaches in the Hima-

laya *D. deltoidea* WALL. but does not mingle with it. It is noteworthy that *D. deltoidea* which produces shorter blades, has longer petioles than *D. prazeri*; also that it requires less humidity.

Econ. The rhizome of both is used for soap in India, particularly for washing the hair as the saponin in it kills lice.

**2. *D. membranacea* PIERRE ex [CRAIB, Kew Bull. (1912) 407, name only] PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 13; R. KNUTH, Pfl. R. 87 (1924) 315; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 59, pl. 7.—Fig. 5b.**

Rhizome wide-running, perhaps even to 2 m,  $\frac{1}{2}$ –1 cm diameter, dark brown, with white flesh. Stem slightly ridged, unarmed, with stipule-like processes at the base of the petioles on the better developed axes. *Leaves* deeply trifid above a cordate base, shortly acuminate, 9-nerved, two primary nerves reaching the forerunner tip along with the midrib and the second pair reaching the tips of the lateral lobes; petiole  $\frac{1}{2}$ – $\frac{2}{3}$  the length of the blade. *Male flowers* in small subsessile cymes with up to 4 flowers, spaced along a leafless conspicuously angled axis; bracts ovate-acuminate, very thin in texture,  $\frac{1}{2}$  mm long; pedicels exceedingly short. Tube of the flower campanulate or urceolate, 1 mm long, its thin walls strengthened by the vascular bundles which descend in it from the insertion of the filaments; tepals 1 mm long, long-ovate, obtuse, 1-nerved. Stamens all alike, the filaments inserted just below the tepals, incurved, 0.3 mm long; anthers introrse, small. *Female flowers* on downwardly directed spike-like racemes; axis angled, to 20 cm long or even longer; pedicels 1 mm; bracts ovate-acute, very thin,  $\frac{1}{2}$  mm. Tube of the flower absent. Outer tepals obovate, obtuse, just exceeding 1 mm, inner ones lanceolate, a little shorter than the outer. Style short. *Capsules* 1–2 cm apart and scarcely imbricate, wings a little broader than semicircular and sometimes widest above the middle, retuse at the apex, nearly truncate at the base.

Distr. From Siam westwards to N. Burma and eastwards into Cambodia; southwards passing beyond the Isthmus of Kra into *Malaysia* to the Siamese Circle of Phuket. Fig. 7b.

Ecol. Like *D. prazeri* it grows on limestone at its southern limit.

**3. *D. palawana* PRAIN & BURK. Kew Bull. (1925) 59; Ann. R. Bot. Gard. Calc. 14 (1936) 52, pl. 22.**

Rhizome imperfectly known, but slender, branching, brown in colour with white flesh. Stem smooth. *Leaves* cordate-sagittate with rather elongated auricles that are distally rounded, 9 cm long by 8 cm across the auricles and 4 cm above them; primary nerves 5, the two outer forking and curving in the auricles; upper surface shining; lower dull; petiole about as long as the blade. *Male flowers* in small cymes disposed on solitary, probably horizontal, rather stiff axes which sometimes carry small branches at the base; the cymes up to 2 cm apart; axis angled, to 30 cm long; pedicels to 1 cm long. Tube of the flower extremely short; tepals ovate, spreading in anthesis so much as to make the flower almost patelliform. Outer tepals a little broader than the inner ones, to  $\frac{1}{2}$  mm in length. Stamens 6, on very short filaments which raise the anthers so that they touch at the centre of the flower. *Female plant* unknown.

DISTR. *Malaysia*: Philippines (N. Palawan). Fig. 7c.

Note. It is feared that the only specimen which was obtained, was lost in the destruction of the Bureau of Science, Manila, in 1945.

**4. *D. ridleyi* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 12; R. KNUTH, Pfl. R. 87 (1924) 191; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 69, pl. 33.**

Lower parts unknown. Stem terete, unarmed at least in the upper parts. *Leaves* subcordately ovate to narrowly ovate, acuminate, the largest seen 11 by 6 cm, but larger are to be expected and these will be more cordate, 7-nerved; petiole rather short, approximately  $\frac{1}{3}$  the length of the blade. *Male plant* unknown. *Female flowers* on decurved branches to 30 cm long. Tepals ovate. Capsules spaced so that they scarcely imbricate; wings broader than semicircular and widest in the upper third, to 22 by 22 mm; the capsule truncate above and drawn out into the stipe below. Seeds with a pale brown wing.

Distr. *Malaysia*: Borneo (Sarawak). Fig. 7d.

Note. The underground parts are needed to confirm the conclusion, arrived at from the shape and poise of the capsule, that it belongs to the section *Stenophora*.

## 2. Section *Stenocorea*

PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 40; R. KNUTH, Pfl. R. 87 (1924) 310; *em.* PRAIN & BURK. Kew Bull. (1931) 88; Ann. R. Bot. Gard. Calc. 14 (1936) 70.—*Peripetasma* RIDL. J. Bot. 58 (1920) 147.—Fig. 5e.

Underground one or more descending tubers. Plants glabrous, stems twining to the left, apparently unarmed. Bulbils unknown. *Leaves*, it seems, always alternate, typically cordate, but not invariably (*cf.* *D. stenomeriflora*). *Male flowers* pedicellate, one at a time along leafless branches which are decurved in all the species except *D. stenomeriflora*; the pedicel carries a bracteole above mid-length and is reflexed in all the species except *D. stenomeriflora* so that the flower faces upwards.

**Stamens 6.** *Female flowers* distinctly pedicellate, on decurved spike-like racemes similar to those of the male except that the pedicels do not become reflexed.

Distr. Siam, Cambodia to 15° N, in *Malaysia*: E. Sumatra, Celebes, Central Java; apparently never abundant.

#### KEY TO THE SPECIES

1. Male flowering axes spreading and their flowers directed forward. Leaves very much longer than broad.

5. *D. stenomeriflora*

1. Male flowering axes decurved and flowers reflexed. Leaves cordate.

2. Leaves twice as long as broad.

3. Pedicels of male flowers to 1½ mm long. (Capsules to c. 25 mm long) . . . . . 6. *D. daunaea*

3. Pedicels of male flowers to 4–5 mm long. (Capsules unknown) . . . . . 7. *D. keduensis*

2. Leaves nearly as broad as long. (Capsules of great size, their fertile part even to 40 mm along the placenta; the stipe much elongated) . . . . . 8. *D. sumatrana*

**5. *D. stenomeriflora*** PRAIN & BURK. J. As. Beng. new ser. 10 (1914) 40; R. KNUTH, Pfl. R. 87 (1924) 310; RIDL. Fl. Mal. Pen. 4 (1924) 319; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 72, pl. 30–31.—*Peripetasma polyanthum* RIDL. J. Bot. 58 (1920) 147; Fl. Mal. Pen. 1 (1922) 103; *ibid.* 5 (1925) 340.

Lower parts unknown. Stem vigorous, recorded as climbing to 25 m, ridged. *Leaves* herbaceous, long-elliptic, 16 by 5 cm, base obtuse or rounded; at lower horizons large sagittate leaves up to 28 by 16 cm occur, but it is questionable if a sagittate outline always occurs; primary nerves 3–5, and the outer of them give a branch to the auricle in the large leaves; secondary nerves very distinct from the network, widely spaced, crossing the space between one primary nerve and another without interruption; upper surface shining; petiole short, ¼ to ⅛ the length of the blade, narrowly winged, these wings pass into the outer primary nerves at the back of the blade as in *D. bulbifera* and certain other species. *Male flowering axes* on short leafless branches, to 35 cm in length, stretching outwards from the upper leaf-axils and bearing possibly more than 100 flowers. Flowers produced singly; from the midrib of the bract of each a pronounced ridge descends the axis; bracts lanceolate, keeled, to 2 mm long; pedicels to 2 mm long, directed obliquely forward. Torus expanded into a wide cup. Outer tepals lanceolate, obtuse, just over 1 mm long, 3-nerved; inner ones similar, but a little less acute. Stamens 6, inserted at the base of the flower; filaments short, stout at the base, incurved, not long enough to lift the anthers out of the cup. *Female flowering axes* solitary or 2–3 together, decurved from the axils of distal leaves or sometimes on short leafless branches; axis conspicuously angled. Bracts lanceolate-ovate, to 1½ mm long. Tube of flower 1 mm deep. Outer tepals narrowly ovate, to 3 mm long, subacute, inner ones a little shorter. Capsules not yet known.

Distr. *Malaysia*: Malay Peninsula (Perak to Singapore), Sumatra (East Coast).

Ecol. Fl. Febr.–April, Oct. (Perak), fr. 2 months later, both flowerings occurring at times when the mountains have heavy rains.

Note. This has been described by error as a new genus, *Peripetasma*, in the *Menispermaceae*.

**6. *D. daunaea*** PRAIN & BURK. J. As. Soc. Beng. new ser. 4 (1908) 450; *ibid.* 10 (1914) 12; R. KNUTH, Pfl. R. 87 (1924) 191; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 73, pl. 32 & 32/2.

Tubers apparently more than one a year, descending deeply into the soil from the corm. *Leaves* lanceolate-ovate-sagittate, shortly acuminate, to 16 by 6 cm (acumen 8 mm long), 5–7-nerved; secondary nerves rather distinct as they traverse the network; upper surface bright; lower paler; petioles to 4 cm. *Male flowering axes* solitary or 2 together, or sometimes on short leafless branches, or branching themselves, i.e. they tend to be paniculate; axis straight, angled; bracts lanceolate-acuminate. Pedicels to 1 mm long. Buds globose. Torus making a cup 1½ mm deep. Outer tepals ovate, acute, inner ones blunter and a little broader. Stamens 6, 3 upright and 3 inclined towards each other. *Female flowering axes* solitary, either from the axils of the leaves or from axils of bracts replacing the leaves on short branches which grow to 30 cm long; axes winged. Bracts ovate-acuminate, 3 mm long. Pedicel in anthesis 3–4 mm. *Capsule* (rather before complete maturity) with wings 25 by 12 mm, semicircular except that the widest part is rather above mid-length and that they are slightly drawn out at the base; apex truncate.

Distr. Mountains of the Tenasserim-Siam border and those SE of Bangkok, and southwards in *Malaysia* to the southern parts of Peninsular Siam.

Ecol. Fl. Jan.–March at which time there is little rain.

**7. *D. keduensis*** PRAIN & BURK. ex BACKER, Handb. Fl. Java 3 (1924) 114; Ann. R. Bot. Gard. Calc. 14 (1936) 74, pl. 90 in part 2 (1938).

Lower parts unknown. Stem faintly ridged. *Leaves* long-cordate or cordate-linguiform, acuminate, to 14 by 5 cm, 5-nerved; petiole about ½ as long as the lamina. *Male flowering axes* solitary or 2 together from a leaf-axil, to 18 cm long. Flowers solitary, to 30 in number or more on each axis; axis angled. Bracts lanceolate-acuminate, to 2 mm long. Pedicels 4–5 mm long. Buds pear-shaped. Flowers wide open in anthesis; tube very short. Outer tepals narrowly ovate, obtuse, 2 mm long,

inner ones a trifle longer and blunter. Stamens inserted at the base of the perianth lobes. *Female plant* unknown.

Distr. *Malaysia*: Central Java, SW. Celebes.

**8. *D. sumatrana* PRAIN & BURK.** Kew Bull. (1931) 90; Ann. R. Bot. Gard. Calc. 14 (1936) 75, pl. 32/3.—**Fig. 5c.**

Lower parts unknown. Stems apparently terete. *Leaves* cordate but not exactly so, because the auricles tend to be drawn out rather than rounded, to 9 cm across, 5–7-nerved; secondary nerves not conspicuous in the network; petiole *c.*  $\frac{1}{2}$  as long as the blade. *Male flowering axes* solitary or 2–3 together, directed downwards from the axils of upper leaves or not infrequently on short special leafless branches: axis rigid, up to 15 cm, many-

flowered; bracts lanceolate, reflexed along with the pedicel, acute. Pedicels to 1 mm. Tube of flower in anthesis  $\frac{1}{2}$  mm deep. Tepals long-ovate, acute,  $1\frac{1}{2}$ –2 mm long. Stamens inserted below the tepals with their filaments inclined towards the centre of the flower, 3 of them shortest. *Female flowering axes* solitary, directed stiffly downwards from the axil, with numerous flowers which face forward and remain facing forward while the pedicel, at first 3–4 mm long, grows into a curved stipe 2–3 cm long. Tepals lanceolate-acute, 2 mm long. Capsule remarkably large (fig. 5e), facing earthwards; wings 4 by  $3\frac{1}{2}$ –4 cm; apex retuse; base drawn out into the stipe. Seeds winged to a width of 3 cm.

Distr. *Malaysia*: Sumatra (East Coast).

Note. The size of the capsule is not approached in any other *Dioscorea*.

### 3. Section *Combilium*

PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 19; R. KNUTH, Pfl. R. 87 (1924) 186, in small part only; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 79.—**Fig. 5c.**

Tubers 4 to many, thrust downwards from a corm lying close to the surface of the soil, esculent, and protected in the wild plant by a formidable *cheval-de-Frise* of thorny roots, wherein the longest thorns are those directed upwards; but races of cultivation are largely without thorns. Plant abundantly hairy with T-shaped hairs (fig. 6a). Extra-floral nectaries are of the deep kind (see p. 294). Bulbils absent. *Leaves* alternate, entire and cordate or broadly cordate. *Male flowers* almost always one at a time distributed along rather stiff axes which ascend from distal leaf-axils; if there be more than one flower the arrangement is cymose. Torus expanded into a saucer-shaped tube. *Female flowers* on decurved spikelike racemes; capsules reflexed.

Distr. Monotypic, native in SE. Asia and *Malaysia*, widely dispersed by cultivation.

**9. *D. esculenta* (LOUR.) BURK.** Gard. Bull. S. S. 1 (1917) 396, 3 pl.; *ibid.* 2 (1919) 159, 1 pl.; MERR. En. Philip. Fl. Pl. 1 (1922) 216; R. KNUTH, Pfl. R. 87 (1924) 189; BURK. Dict. (1935) 818; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 80, pl. 35–37.—*Combilium* RUMPH. Herb. Amb. 5 (1747) 357, t. 126.—*D. sativa* LINNÉ, Sp. Pl. (1753) 1033 in small part, and in confusion by most later taxonomists; DENNST. Schlüss. Hort. Malab. (1818) 34; BLANCO, *op. cit.* (1845) 551; NAVES in BLANCO Fl. Filip. ed. 3 (1880) 209.—*D. aculeata* L. (not of Sp. Pl. 1753) Herb. Amb. (1754) 23; Syst. Nat. ed. 13 (1791) 582; MIQ. Fl. Ind. Bat. 3 (1859) 575; QUEVA, Mém. Soc. Sc. Lille IV, 20 (1894) 373; WESTER, Philip. Agr. Rev. 9 (1916) 194, with plates; BACKER, Handb. Fl. Java 3 (1924) 112; RIDL. Fl. Mal. Pen. 4 (1924) 315; HEYNE, Nutt. Pl. N.I. (1927) 455; OCHSE, Veg. D.E.I. (1931) 22.—*Oncus esculentus* LOUR. Fl. Coch. (1790) 194.—*D. fasciculata* ROXB. Fl. Ind. 3 (1832) 801.—*D. papillaris* BLANCO, Fl. Filip. (1837) 801, ed. 2 (1845) 552.—*D. tugui* BLANCO, *op. cit.* (1837) 800.—*D. tiliifolia* KUNTH, En. Pl. 5 (1850) 401; MIQ. *op. cit.* 3 (1859) 576; CERON, Cat. Pl. Fl. For. (1892) 171; KOORD. Exk. Fl. Java 1 (1911) 311; R. KNUTH, Pfl. R. 87 (1924) 188.—*D. spinosa* ROXB. ex HOOK. f. Fl. Br.

Ind. 6 (1892) 291 as regards the male plant.—*D. papuana* WARB. Bot. Jahrb. 13 (1891) 273; in KRIEGER, Neu Guinea (1899) 65; K. SCH. & LAUT. Fl. D. Schutzgeb. Süds. (1901) 223.—**Fig. 5c, 6a.**

Tubers as described above, protected by thorny roots in the wild plant and by man's vigilance in cultivation; skin of the tubers bright brown or gray-brown, thin so that the tuber is easily bruised, often rough with indurated bases of rootlets; flesh white, sometimes with a trace of bitterness at the surface, but on the whole sweet and esculent. When the tubers are many, they tend to be shortly cylindric with both ends rounded; when they are few and relatively larger as in various cultivated races, they may be lobed; sometimes they are large and may weigh over 3 kg. *Plant* pubescent with T-shaped hairs, the shank of which varies in length and when short brings the tomentum close down on the epidermis; the cross piece is of a single cell; exposed surfaces are glabrescent. *Stems* 1 or rarely more, terete, prickly at the base and diminishly so upwards: basal internodes carry prickles, medial at the nodes only, one at each side of the petiole and distal none. *Leaves* when very large to 15 by 17 cm, but most of them do not exceed 10 by 10 cm, acuminate acute at the apex, the forerunner tip a

small mucro, 9–13-nerved; secondary nerves fairly regular but not conspicuously ladder-like; petiole 1–1½ times as long as the blade, sometimes with small prickles in its pubescence. *Male flowering axes* almost invariably solitary, carrying flowers one at a time or very rarely 2–4 in a small cyme, the flowers to 70 or more; axis slightly angled. Bracts ovate-acuminate, to 2½ mm long. Pedicels to 1¼ mm, but usually nearly absent. Torus a shallow cup. Outer tepals broadly lanceolate, acute, 1¾ mm, inner ones a trifle shorter. Stamens all alike inserted just below the perianth lobes, the vascular bundle strengthening the cup, forming a ridge; filament 1 mm long, curved so as to cause the anthers to dehisce upwards. *Female flowering axes* solitary from upper leaf axils, to 40 cm, decurved, slightly angled. Bracts ovate, acuminate, 2 mm long. Pedicels in anthesis very short. Torus scarcely developed into a tube under the perianth lobes. Outer tepals lanceolate-ovate, obtuse, 1½ mm long, inner ones more acute. *Capsules* (only one seen and it not quite ripe) reflexed, 27 by 12 mm, subretuse at the apex and nearly truncate at the base. Seeds winged all round.

Distr. Native in Siam and Indo-China, but very local; also growing wild, but without certainty of being indigenous, in the Sontal Hills of N. India, on Mt Popa in central Burma, in the Shan Hills, and perhaps in New Guinea. By A.D. 1498, when the Portuguese found their way into the Indian Ocean, it had obtained a dispersal in cultivation from Madagascar to Tahiti; and it appears to have had centres of relatively intensive cultivation in two parts of northern India, in Burma and Siam and in and around either end of New Guinea. As a servant of man it does not equal *D. alata*; but it can be raised where the humid season is short for *D. alata* and a return taken at 6 months, which is before the tubers become firm and fibrous. After A.D. 1500 it was carried round the Cape to the shores of the Atlantic in company with *D. alata* but not in rivalry. Those parts of Malaysia without a dry monsoon are rather too humid for its thrift.

Out of the wild population in the remote time when he became conscious of primitive agriculture man has acquired by selection forms with larger tubers, getting fewer at the same time, and lobed tubers, and his operations reduced the armature of thorny roots. It is convenient to distinguish the two intergrading varieties<sup>1</sup> upon which ROXBURGH based two species as:

*var. spinosa* (ROXB.) PRAIN & BURK. (1914).—*D. spinosa* ROXB. l.c., non BURM.—Plants well provided with thorny roots.

*var. fasciculata* (ROXB.) PRAIN & BURK. (1914).—*D. fasciculata* ROXB. l.c.—Plants ill-provided with thorny roots.

There are some cultigens in *var. spinosa* and

with them all the truly wild plants; *var. fasciculata* consists entirely of cultivated plants.

Plants in the field-crops of India never flower, and certain races never do so in Malaysia. In what measure this may be a climatic response or alternatively a consequence of the gathering of the crop is unknown. On the other hand some of the races cultivated in Malaysia never flower freely, or if they flower do so in the male sex only; everywhere it is extremely rare for any form of the female plant to flower; and fruiting does not follow.

A good idea of the range in shape of the tubers is found in the two cited papers from the Gard. Bull. Str. Settlement.

RUMPHUS writing between 1653 and 1692, stated of Malaysia, that *D. esculenta* was cultivated in the greatest degree from Celebes through Buton, to the Moluccas, Ambon and Banda; and was to be found in Java, Bali and Bima, but not in great quantity though particularly near Jakarta to which centre immigrants from among the eastern folk had taken it.

Vern. Malay and Sundanese names sustain the view that W. Malaysia has obtained both *var. fasciculata* and *var. spinosa* from E. Malaysia. Both languages hold names distinguishing the two varieties, while linking it to *D. alata*; in Malay the names *ubi tēropong* (pipe *D. alata*) and *ubi torak* (trident yam), and in Sundanese *huwi taropong* and *huwi landak* (porcupine *D. alata*) are used.

The first of each pair is *var. fasciculata*; the second, as the qualifying words show, is *var. spinosa*. There is also a name in Javanese, *uwi mayong* (cat-fish *D. alata*), which provides another indication of the cultivation in Java of *var. spinosa*. RUMPHUS excludes *D. esculenta* from the genus *ubi*, giving its proper name as *kombili*. He does not state that any of the races in Ambon were altogether without thorns, but he states that the fewer the thorns the better the race; and his kind with numerous tubers, which was grown in garden fences where it never flowered, was certainly *var. fasciculata*. Among the others was *var. spinosa*. The noun *kombili* becomes *kēmbili*, *gēmbili*, *gēmbilim*, *gēmbilēm*, *gēmbolo*, *gēmbulu*, *kēmili* and *bili* in western Malaysia, and is applied also to *Coleus tuberosus*. BLUME seems to have been aware of the confusion when he called the *Coleus* 'kummuli java' (Bijdr. 1826, 838). It is a strange confusion; for appearance and taste are very distinct.

Through the area which RUMPHUS indicates as that of intense cultivation, *D. esculenta* is known today by a noun of considerable variability and completely specific. It is *siawu*, *siavu*, *siapu*, *sayawu*, *sayabu*, *sayahu*, *sayafu*, *sayahul*, *siaho*, *sahu*, *siyau*, *hiyahu*, *isahu* and *isayahu*. An outflow of the noun from the area is to be expected, and perhaps is seen in the use of *sahe* in N. Borneo; and in *uwi sayawu* of N. Celebes. The relationship of *siawu* to *sudo* or *wisudo* employed in eastern Java and Bali is not evident; *wi* here equals *uwi*. Where Buginese and Makassarese are spoken this plant is known as *opa* or *oppa*; and an apparent outflow of it is the name *ubi opang* recorded from Java. In the same languages of Celebes the yam is liable to be

(1) It is not possible to assign LOUREIRO's type to one of these varieties as LOUREIRO's specimen is insufficient and his account of the underground parts is too poor.

classified under *lame*, as *lame chengka*, but may be simply *chengka* or *chingka*. The outflow of names of the *siawu* group towards the north is blocked by equally firmly established names of more than one group. Thus in the Bisayan languages of the central Philippines *bodot*, *borot*, *bolot*, *bolod* is established in a way that makes another name unnecessary, until the speaker seeks to indicate races, and in the languages of W. Luzon, *tugui*, *tuqui*, *tugi*, *dogue*, *toguing*, *tungo* and *tongo* does the same up to a certain point. In Ilocano, Sambali and Tagalog *boga* and *buga* are used, to denote a race. The names recorded from New Guinea seem to have racial values; for instance *diba*, *nemu* and *taitukava* in the Hanuabada language of the E. end of the island have racial values. Lastly it would seem useful to list some dissimilar names that they may not miss attention by those interested in the languages; they are as unlike each other as the names of wider use given above; given alphabetic-

ally they are:—*aneg* (Ibanag of Luzon); *bangan* (Sambali of Luzon); *biau* or *bihaun* (Bali); *dukai* (Ivatan of the islands N of Luzon); *invod* (Palawan); *kaburan* (Madura); *kamiging* (Bikol of S. Luzon); *karat* (Pangasinan of W. Luzon); *katilin* (Ceram); *luttu* (Ibanag of Luzon); *nale* (S. New Guinea). BRANDERHORST in recording the last name connects it with a verb meaning to eat.  
It is not at present useful to enumerate the many double names under *ubi*, *huwl*, etc. that are racial; it may suffice to suggest that there are several races spread from Burma to the eastern parts of Malaysia, varying in name but not in nature; and to add they do not vary in nature because reproduction is entirely by clones so that the characters are constant; and the main direction of the prehistoric spreading of this useful plant has been out of the continent of Asia through the Philippines, thence to diffuse towards the S and SE, and ultimately towards the SW.

4. Section *Paramecocarpa*

PRAIN & BURK. Gard. Bull. Str. Settl. 3 (1924) 123 *in nota*; Ann. R. Bot. Gard. Calc. 14 (1936) 93.—*Sect. Combilium* R. KNUTH, Pfl. R. 87 (1924) 186, in part.—*Sect. Celebenses* R. KNUTH in FEDDE, Rep. 36 (1934) 128.—**Fig. 5d, 8.**

Tubers descending into the soil, apparently not to a considerable depth, protected against herbivores in some *spp.* and probably in all by a poisonous saponin in addition to thorny roots on the surface of the tubers. Corm little developed for new tubers appear in the axils of scale leaves against the soil, as if misplaced bulbils. Hairs, when present, of the stiletto shape as in *D. pyrifolia* of § *Enantiophyllum* (fig. 6d). Extrafloral nectaries of the deep kind exist, at least in *D. piscatorum*. Bulbils not recorded. *Leaves* entire, cordate, alternate, chartaceous. *Male flowers* one at a time along spreading flowering axes. Torus expanded into an infundibular tube from the rim of which the tepals become reflexed during anthesis. *Female flowering axes* decurved, carrying numerous pedicellate flowers which face forward; but after fertilization the pedicel lifts the capsule to a horizontal position (fig. 5d). Style stout. *Capsules* horizontal when ripe or very slightly ascending, elongated, their sides parallel. Seeds with a triangular body and winged from it on the outer side and forward (in the Tonkin species also from the base).

Distr. *Ca 5 spp.*, from the S. border of China southwards to *Malaysia* as far as the equator and to Palau Islands. Fig. 8.

Notes. The section approaches *Stenomeris* in: (i) a great demand for humidity, (ii) the elongation of the capsules, with (iii) forwardly directed wings on elongated seeds, and (iv) reflexed perianth lobes. When KNUTH described *D. kjellbergii* he suggested a new section *Celebenses*; but beyond all doubt this species is a typical member of the section *Paramecocarpa*.

KEY TO THE SPECIES

1. Stem (as far as known) sparingly prickly. Leaves about as broad as long. Hairs on the inflorescence and rather sparingly on the backs of the leaves.  
2. Leaves about 13 by 13 cm. Tepals 1½ mm long . . . . . 10. *D. flabellifolia*  
2. Leaves about 10 by 8 cm. Tepals ½ mm long . . . . . 11. *D. kjellbergii*
1. Stem with long crests of confluent prickles on the lower internodes. Leaves distinctly longer than broad and half as large again as those of *D. flabellifolia*, glabrous. (Inflorescences unknown.)  
12. *D. piscatorum*
10. *Dioscorea flabellifolia* PRAIN & BURK. in EL-MER, Leaf. Philip. Bot. 5 (1913) 1593; J. As. Soc. Beng. new ser. 10 (1914) 12; MERR. En. Philip. Fl. Pl. 1 (1922) 217; R. KNUTH, Pfl. R. 87 (1924) 188; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 94, pl. 38–39.—*D. ledermannii* R. KNUTH, Pfl. R.

87 (1924) 188; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 209; *ibid.* (1938) 425.—*D. bullata* PRAIN & BURK. Kew Bull. (1925) 60; Ann. R. Bot. Gard. Calc. 14 (1936) 96, pl. 40.—Fig. 5d.

Tuber unknown. Plant to some extent hairy, but glabrescent. Stem to 14 mm in diam. at the base

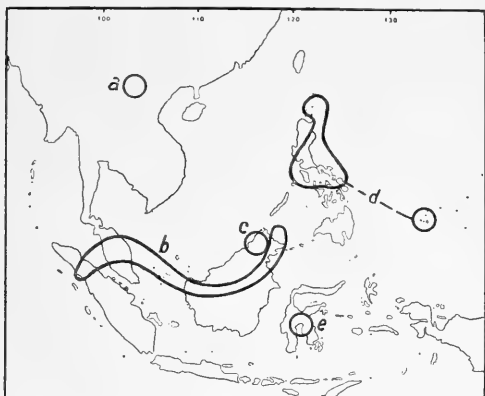


Fig. 8. Distribution of the spp. of *Paramecocarpa* in SE. Asia: a. *D. petelotii* PR. & B., b. *D. piscatorum* PR. & B., c-d. *D. flabellifolia* PR. & B., e. *D. kjellbergii* R. KNUTH. Note a similarity to the distribution of *Stenomeris* (fig. 3, p. 299).

and there abundantly prickly, above with scattered small prickles. *Leaves* almost exactly cordate, with the margin very evenly rounded, shortly acuminate, to 16 by 20 cm, but as a rule not larger than 13 by 13 cm, 9-nerved; primary and secondary nerves distinct above and somewhat impressed, prominent below, the secondary almost ladder-like; surfaces of the lamina equally bright on the two sides; petiole puberulous or pubescent, shorter than the lamina by  $\frac{3}{4}$  to  $\frac{1}{3}$ . *Male flowering axes* 1-4 together from the axils of upper leaves, more or less ascending and sometimes erect, to 45 cm, carrying upwards of 70 pale green flowers which are for the most part solitary though there may be sometimes a second flower cymosely on the pedicel of the first; axis conspicuously ridged. Bracts lanceolate, acute, puberulous, 3 mm long; bracteoles placed rather above the middle of the pedicel. Torus a funnel-shaped perianthoid tube  $\frac{1}{2}$  mm. Tepals lanceolate, ridged on the inner face just within their margins and down the middle line,  $1\frac{1}{2}$  mm long. Stamens inserted just below the tepals, raising their anthers well out from the tube; filaments  $\frac{1}{2}$  mm long. *Female flowering axes* to 80 cm, sometimes branched, axis strongly ridged. Tepals recurved as in the male, but less sharply,  $1\frac{1}{2}$  mm long. Stigmas big, extruding from the flower. Pedicel 6-8 mm long in anthesis. Ovary more or less pubescent. *Capsules* horizontal from the downwardly directed axis or perhaps slightly ascending by being reflexed through rather more than  $90^\circ$ ; wings to 35 by 9 mm, the obtuse apex raises the withered remains of the flower by 1-2 mm; stipe to 1 cm. Seeds inserted on the lower

half of the placenta, their outer margin narrowly winged, wing widening upwards and extended from the apex of the seed towards the apex of the cell, to 35 mm long wing included.

Distr. Micronesia (Palau), in *Malaysia*: Philippines (Luzon, Mindoro), Br. N. Borneo. Fig. 8c-d.

Ecol. Chiefly in the eastern more humid parts of Luzon.

Vern. *Paynut* (Tagalog).

Note. The Palau specimen described as *D. ledermannii* KNUTH is tentatively referred here, the capsule being slightly different from the Philippine plant.

**11. *Dioscorea kjellbergii* R. KNUTH in FEDDE, Rep. 36 (1934) 128.**

Lower parts unknown. Inflorescence thinly hairy and a few hairs on the leaves. Stem terete in its distal parts, to 5 mm in diam., unarmed, firm in texture, glabrous except in the leaf-axils. *Leaves* at the horizon of flowering to 11 by 9 cm (assuredly larger at a lower horizon), very shortly acuminate, 7-nerved with firm margins; the secondary nerves ladder-like; petiole to 5 cm. *Male flowering axes* solitary from upper leaf-axils or on very short leafless branches, 10-20 cm, carrying 20-30 flowers which are directed slightly forward; axis angled. Bracts ovate, acute,  $\frac{1}{2}$  mm long. Pedicel 1-2 mm, with scattered hairs, with a bracteole in its lower part. Funnel-shaped perianthoid torus-tube nearly 1 mm deep; tepals long-deltoid  $\frac{1}{2}$  mm long. Stamens inserted just below the perianth lobes; anthers conspicuously exserted, opening upwards. *Capsules* (teste R. KNUTH) on axes to 60 cm long, in a slightly immature state 40 by  $12\frac{1}{2}$ - $17\frac{1}{2}$  mm.

Distr. *Malaysia*: Central Celebes (Malili). Fig. 8e.

Ecol. Rainforest at sea-level, fl. August and with not quite mature fr.

**12. *Dioscorea piscatorum* PRAIN & BURK. Gard. Bull. Str. Settle. 3 (1924) 123; R. KNUTH, Pfl. R. 87 (1924) 356; RIDL. Fl. Mal. Pen. 4 (1924) 319; BURK. Dict. (1935) 822; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 98, pl. 41.—*D. borneensis* R. KNUTH, *op. cit.* 188.—*D. sp.* PRAIN & BURK. J. As. Soc. Beng. 73 (1904) 186; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 84; Agric. Bull. Str. & F.M.S. 7 (1908) 444; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 13.**

Tubers more than one, clavate, arising in axils where the base of the stem touches the soil surface, unarmed or with short roots which may be indurated into thorns, some of which (teste KEITH) come above the soil; skin liver-coloured; flesh the red colour of diluted blood, intensely poisonous. Plant glabrous. Stems to 8 mm in diam. near the ground where there are 4-5 lines of confluent flat prickles; these give place upwards to scattered prickles and then more or less cease. *Leaves* except in their greater size and complete glabrousness as those of *D. flabellifolia*, attaining 18 by 14 cm, 9-nerved; petiole shorter by  $\frac{1}{4}$  than the blade, with scattered small prickles on the back and the sides.



Flowers unknown, acc. to KNUTH those of his '*D. borneensis*' are formed on male inflorescences reaching a length of 70 cm.

Distr. *Malaysia*: N. Sumatra, Malay Peninsula (Perak and Pahang, P. Tioman), and Borneo. Fig. 8b.

Ecol. The saponin in the tubers stupefies fish and the tubers are used as an alternative to *Derris*. Attention was drawn to this in 1908 by a Malay who exhibited the plant at an Agri-Horticultural Exhibition in Kuala Lumpur. BURKILL & HOLTUM proved the effect (see BURK. Dict. 822); GATER tried the tubers as an insecticide and found them effective, but less so than *Derris*. Being a substitute

for *Derris* it shares the name *tuba*, and is known as *tuba ubi* (*tuba yam*) in the Malay Peninsula, *tuba gunjo* (wild *tuba*) among the Battaks of Tapanuli and *tuba podeh gantung* among the Dayaks of the Sanggau valley of Borneo. It is recorded that rasped tubers are put into the runnels of rice fields in Tapanuli 'to kill injurious worms'. Beyond all doubt the tubers are inedible to such animals as wild pig and are preserved from molestation by their poisonousness as well as by their thorny roots. Ignorance of the flowers is probably due to flowering not occurring until the climber has topped the forest.

### 5. Section Opsophyton

ULINE in E. & P. Nachtr. (1897) 84; R. KNUTH, Pfl. R. 87 (1924) 88 *pro subsect. Euopsophyton*; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 109.—Fig. 4a–b, 5f.

Tuber annually replaced, solitary, produced close under the surface of the soil, swelling downwards from a rather thick attachment; in Asia and the East that attachment does not possess any length, but in Africa it makes a definite stalk; flesh poisonous in varying degree, the least poisonous being cultigens derived from *D. bulbifera*. Hairs as a rule absent, when present finger-like and of one cell. Extrafloral nectaries of the superficial kind. *Leaves* cordate, alternate. *Male flowers* in spikes or spike-like racemes which may be collected together into large inflorescences; torus without enlargement, tepals long and narrow. *Female flowers* on decurved axes and after pollination the ovary is reflexed. *Capsules* twice as long as broad or relatively longer. Seeds winged towards the base of the cell.

Distr. *Ca* 5–6 *spp.* native in the Old World, only one *sp.* in *Malaysia*.

13. *Dioscorea bulbifera* LINNÉ, Sp. Pl. (1753) 1033; BL. En. Pl. Jav. 1 (1827) 23; MIQ. Fl. Ind. Bat. Suppl. (1860) 270; J. Bot. Néerl. 1 (1861) 90; WARBURG, Bot. Jahrb. 13 (1891) 273; CERON, Comis. Fl. Forest. (1892) 171; PRAIN, Beng. Pl. (1903) 1066; KOORD. Exk. Fl. Java 1 (1911) 309, Atlas (1923) fig. 501; KOORD.-SCHUM. Syst. Verz. 9 (1912) *gen.* 1252; MERR. Interpr. Herb. Amb. (1917) 146; EN. Philip. Fl. Pl. 1 (1922) 215; HEYNE, Nutt. Pl. Ned. Ind. (1922) 496; R. KNUTH, Pfl. R. 87 (1924) 88, *excl. syn. eburina & eburnea*; BACKER, Handb. Fl. Jav. 3 (1924) 113; RIDL. Fl. Mal. Pen. 4 (1924) 315; OCHSE, Veget. D.E.I. (1931) 248; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 111, pl. 49–51; *ibid.* (1938) 420.—*D. sativa* (non LINNÉ, Sp. Pl.) THUNB. Fl. Jap. (1784) 151; BENTH. Fl. Hongkong (1861) 368; Fl. Austr. 6 (1873) 460; K. SCH. & HOLLR. Fl. K.-Wilhelmsl. (1889) 14; HOOK. f. Fl. Br. Ind. 5 (1892) 295; WARBURG, Pfl.-Kl. N. Guin. (1899) 65; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 84; LAUT. Bot. Jahrb. 41 (1908) 224.—*D. crispata*, *D. heterophylla*, and *D. pulchella* ROXB. Fl. Ind. 3 (1832) 801.—*Helmia bulbifera* KUNTH, En. Pl. 5 (1850) 435; QUEVA, Mém. Soc. Sc. Lille IV, 20 (1894) 178, 374.—Fig. 4a–b, 5f.

Tuber (as produced in the East) globose to pyriform, rarely somewhat lobed, usually covered densely with harsh short roots, nauseous in the wild plant and in quantity poisonous; but with

tubers fit to eat in various cultigens selected by man, weighing up to 1 kg. In certain cultigens the tuber is suppressed in favour of rather large bulbils. In the wild plant bulbils numerous; a seedling only a few months old can be made to produce one by a checking of its growth; bulbils usually in the leaf-axils but at times displacing ♂ flowers at the base of flowering axes; small bulbils are as a rule warted; when large they may be smooth; in Africa curiously angled bulbils are produced. Flesh usually pale yellow, perhaps tinted with violet, and it oxydizes when cut to orange; very mucilaginous. *Leaves* usually broadly cordate, but sometimes long-cordate [*var. heterophylla* (ROXB.) PRAIN & BURK. (1936)], up to 20 by 20 cm and even to 32 by 32 on unusual plants, 5-nerved, secondary nerves very conspicuously ladder-like; upper surface shining and slightly bullate between the secondary nerves, lower duller, with the nerves prominent; petiole from half as long to as long as the blade, sometimes marginally winged with wings that ascend to the backs of the outer primary nerves; these wings descend on the stem having between them a wing from the centre of the base of the petiole. Subfoliaceous auricles (fig. 4b) may occur at the base of the petiole and partly embrace the stem; they are larger than in any other *sp.*, but they are commonly altogether absent. *Male flowering axes* pendulous, 1–4 from the axil of a bract or rarely



of a leaf; those arising from axils of bracts may make large pendulous inflorescences (fig. 4a) even to 100 cm; axis carrying the flowers to 14 cm, though usually about 4 cm; when large with perhaps 100 flowers which open from the lowest upwards in a succession that is often by no means as obvious in the genus; flowers facing forwards which, the axis being pendulous, means towards the earth, pleasantly scented, sometimes tinted with a rose coloured pigment and generally with the green so diluted that collectors have called them white. Torus very small, tepals and stamens crowded together. Outer tepals linear-lanceolate,  $1\frac{1}{4}$ –4 mm long, but nothing like the large flowers of the Himalayan *var. simbha* PRAIN & BURK. (1914) have been met with in Malaysia; inner ones not so acute. Stamens half as long or a little longer, anthers as long as the filaments. *Female flowering axes* directed downwards but not rigid, solitary or 2 or more together from a leaf-axil, carrying about 40 flowers which appear sessile but after pollination show that they have enough pedicel to direct the ovary upwards. Bracts long-acuminate. Outer tepals rather broader than those of the male and greener, rarely more than  $1\frac{1}{2}$  mm long, inner ones a trifle shorter and blunter than in the male. *Capsules* bright chestnut and usually formed in large numbers, imbricating; wings rounded at both ends (fig. 5f) sometimes rather broader towards the apex than below, 20–22 by 8–9 mm. Seeds as a rule not quite as broad as their wing, but nearly so.

**Distr.** From the Atlantic coast of Africa to the furthest islands of the Pacific, the most prolific and the widest spread of all the *Dioscoreas*. The dry countries from the Sahara to the Punjab interrupt its distribution; and on the African side of this break the plants are liable to carry small hairs which they do not carry in Asia; and they have angular bulbils whereas those of Asia have rounded bulbils; moreover there is the difference noted above in the shape of the tuber. The African plants are conveniently called collectively *var. anthropophagorum* (CHEV.) PRAIN & BURK.

**Taxon.** It is convenient to distinguish some varieties (cf. J. As. Soc. Beng. new ser. 10, 1914, 26 and Ann. R. Bot. Gard. Calc. 14, 1936, 117).

#### KEY TO THE VARIETIES

1. Tubers and bulbils acrid and nauseous; wild plants.
2. Leaves shortly cordate . . . *var. bulbifera*
2. Leaves elongated, long-cordate.
- var. heterophylla*
1. Tubers and bulbils selected by man not to be acrid and nauseous, less or little so.
3. Bulbils dark gray-brown, abundantly warted.
- var. suavior*
3. Bulbils large, smooth, glivous . . . *var. sativa*

*Var. bulbifera* is that met with in Malaysia wherever the plant grows. *Var. heterophylla* is fairly plentiful in Penang in association with the type and has been obtained sparingly to the south as far as Malacca. Its stems are rough at the base. ROXBURGH attributed *var. heterophylla* also to the

Moluccas, but no specimens have been seen derived thence. The known dispersal of the cultigens is given below.

If a growing stem of one of the cultigens with large bulbils be examined, starch is found, often in quantity, within the parenchyma, showing that what man has done is to select races, not with the amelioration of increased starch and food production, but with a loss of ability to transport the elaborated food to the base of the plant. And the plant, therefore, must die each year. Consequently maintenance of its situation is dependent on the bulbils with broken tenancy. Man obtained large bulbils in Asia and Africa, but as said above growing to unlike shapes. The cultigens of the two continents have been distributed widely without intermingling, unless it be in remote Tahiti to which *var. anthropophagorum*, after having been taken to America along with negro slaves was carried to Tahiti by Spaniards after Tahiti had received cultivated *D. bulbifera* from out of Asia. Asia, more progressive than Africa, has gone much further than Africa in abandoning a line that had ceased to reward the cultivator adequately; but there is left a wide dispersal of the Asiatic cultigens to show how they gave at one time an adequate reward. In contrast Africa still cultivates *D. bulbifera* considerably and would seem still to be endeavouring ennoblement.

**Ecol.** From a rather extensive study of *D. bulbifera* in India a climatic limit has been determined towards the dry NW where its existence ceases (PRAIN & BURK. Ann. R. Gard. Calc. 14, 1938, 433–4). This limit is where the rainfall of the wetter six months diminishes to less than 700 mm, an amount seemingly just adequate, though 1000 mm serve better. This observation in India leads to an expectation that there is little land in Malaysia insufficiently humid to provide a home. *D. bulbifera* crosses Torres Straits into Australia and passes down the east coast in the coastal margin to  $21^{\circ}$  S; but here, though the summer rains of Brisbane exceed 700 mm, it does not reach that city. Towards the W. coast of Australia it does not overpass Port Darwin. It ascends the Himalaya to 1800 m and is recorded in Yunnan at 2700 m, heights which cause the records of it on the mountains of Malaysia to be unsatisfying; there are specimens in herbaria from 1000 m in Sumatra, Borneo and Java; it probably exceeds this. Mountains however, are not where it is most abundant; this is always near sea-level and it seems to find a home readily in small islands. It was found in Verlaten Island and Sebesi near Krakatoa when the returning vegetation was investigated (DOCTERS VAN LEEUWEN, Krakatoa, 1936, 435). It gets some dispersal by floating bulbils. The high forest chokes it out; disturbed wooded land is suitable; and in coastal woodland which is always exposed to storm damage as well as to interference by man; storms and man working together produce conditions favourable to it, and so aid in creating a greater abundance of it near the sea than in little inhabited country. The widest distribution of any *Dioscorea* with the greatest amount of reproduction by bulbils points to bulbils as of great value in its thrift. It

may be added here that a seedling, checked at the age of a few weeks, is able to produce a bulbil before its stem perishes down to the ground, and so to carry on as two plants, one from the bulbil and the other from the tuber, the former making trial of a new spot. By its bulbils a female plant, occupying a new site can multiply while awaiting the establishment of a male within pollinating distance. Adult *D. bulbifera* is very floriferous and commonly produces an abundance of seed. The pollinating agents, presumably insects, have not been detected; the flowers are pleasantly scented. Male and female flowers resemble each other, more closely than the flower of the two sexes in many species of *Dioscorea*. The maximum of its flowering in Malaysia north of the equator is in September, and south in May.

Econ. The tubers of wild plants become increasingly unpalatable as the time of new growth approaches. They are bitter and acrid and the backward tribes who fall back on them slice and cook them with lime and wood ashes; the product is rather like starch paste with acidity introduced. 'Vile in taste', wrote RUMPHIUS, adding humourously, 'but suited to the Amboinese stomach'. The bulbils of the varieties *suavior* PRAIN & BURK. (1914) and *sativa* PRAIN (1903) are much pleasanter and the best even pleasant to eat. Until recently the latter existed on the edge of Singapore from former cultivation and the names *ubi china* (Chinese yam) and *ubi kastéla* (Portuguese yam, literally yam of Castile) lingered but without providing proof that the Chinese or Portuguese had brought it either from China or elsewhere. The same variety, cultivated near Jakarta, passed as *huwi singapura* (Singapore yam), as if Singapore had supplied it. It has been found elsewhere in the Malay Peninsula to which it is certainly exotic. *Var. suavior* has been recognized in specimens from Java, Madura, Buru, and Halmahera. Both varieties have been met with among collections from the SE of New Guinea

and from the islands to the eastward. It is interesting that *var. sativa*, as it grows in Singapore, produces fertile female flowers at the base of male axes.

It may be well to remark that PRAIN did not use the name '*sativa*' for his variety in reference to any previous application of that adjective to this species. The earlier applications of the adjective in the form of *Dioscorea sativa* from LINNAEUS to BENTHAM were extremely confused (PRAIN & BURK. in Kew Bull. 1919, 339). BENTHAM in 1861 accepted it as for *D. bulbifera* and for a time many botanists followed him; this was an error for there is no doubt regarding the earlier use of the name *D. bulbifera*. THUNBERG's *D. sativa* was *D. bulbifera* as cultivated in Japan: the type of *D. bulbifera var. sativa* PRAIN is a plant brought to India from the Pacific and cultivated in Jail gardens under the name *Otaheite potato*. The writer has eaten its bulbils and found them pleasant, as cooked.

Vern. The names *ubi atas* (top-side yam) in Malay and *huwi buwah* (fruit yam) in Sundanese, can only be applied to cultivated varieties; and their use is evidence of former resort to these varieties in western Malaysia. In the islands of SE. Malaysia where the importance of *D. esculenta* is declared by consistent naming (see under that species) *D. bulbifera* has names as *abobo*, *abubu*, *ahuhu* and *ohuhu*; but it must be added not without a little confusion with *D. pentaphylla* and *D. hispida*. *Abau*, used for *D. bulbifera* in Solor appears to be of the same group of names; and attention may be directed to similarities in the Javanese names *jebubug* and *kambulu*. There is another name, *boti* and *botil*, used in Roti and Timor to cover it and *D. hispida* (q.v.). *Singal* is an isolated name reported from Timor. In the Bisayan languages of the central Philippines there would seem to be two groups of names, (i) *baong*, *bohayan*, *bayangkan* and *banayan*, and (ii) *pulugan*, *pologan* and *pugang*. In Luzon it is *aribukbuk* (Ilocano) and *ubi-ubihan* or *utong-utongan* (Tagalog).

## 6. Section Lasiophyton

ULINE in E. & P. Nachtr. (1897) 84; *emend.* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 7, to incl. *sect. Trieuphorostemon* and *sect. Botrysicyos* ULINE, *l.c.*; R. KNUTH, Pfl. R. 87 (1924) after ULINE, 131, 137, 150; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 135.—Fig. 5g-o, 6b-c, e.

Tubers renewed annually from a corm that is superficial in the soil, stalked or not, or in *D. hispida* as lobes on the corm, harmless or poisonous, sometimes very poisonous. Plants as a rule pubescent with characteristic hairs (fig. 6b-c, e). In the Malaysian species the lower equidimensional cell of the hair is single; elsewhere it may be doubled. Sometimes both cells are coloured red, sometimes only the lower. Extrafloral nectaries superficial. Stems twining to the left, in most species prickly at the base. *Leaves* alternate palmately compound, usually with 3 or 5 leaflets, sometimes simple. The forerunner tip is not well-developed and in most species receives but a single nerve. *Male flowers* one at a time along the flowering axes; pedicellate (except in *D. hispida*), the pedicel growing out of the stem carries up the bract with the flower. The flower-carrying axes are assembled into large leafless inflorescences.

*Female flowers* on downwardly directed axes and after pollination reflexed. *Capsules* rather longer than twice their breadth. Seeds winged towards the base of the cell.

Distr. Over 20 spp. from the Atlantic to Tahiti.

Anat. ORR (Notes Bot. Gard. Edinb. 15, 1926, 138) describes a lignified coat about the extrafloral nectaries of *D. hispida* such as he detected in none of the other species of *Dioscorea* that he examined.

ULINE subdivided too much when he made three sections out of the material which constitutes this section; his section *Botrysosicyos* cannot be upheld; but it must be admitted that the separation of § *Triumphorostemon* from § *Lasiophyton* can be argued on the differences in the male flowers and the tubers. If *Triumphorostemon* be kept, then 21. *D. hispida* is the only member of § *Lasiophyton* in Malaysia; the rest are in Africa.

#### KEY TO THE SPECIES (♂ plants)

1. Stems as they dry discolouring, indicative of their herbaceous nature. Flowers pedicelled. Fertile stamens 3.
  2. Plants scarcely coarse. Leaflets produced at the horizon of flowering rarely exceeding 10 cm in length.
    3. Pubescence soft but not silky, rusty-red and abundant. Leaf blade herbaceous. Middle leaflet 3–5 times as long as broad . . . . . 16. *D. pentaphylla*
    3. Pubescence silky and very abundant everywhere . . . . . 15. *D. pierrei*
    3. Pubescence short on the inflorescences and scant on the leaves. Middle leaflet 2–2½ times as long as broad.
      4. Flowers 2 mm in diam. Leaf blade coriaceous. Pubescence rusty-red. . . . . 20. *D. scortechinii*
      4. Flowers 1 mm diam. Leaf blade subcoriaceous. Pubescence white on the perianth, but rusty-red on the bracts. . . . . 14. *D. tamarisciflora*
  2. Plants coarse. Leaflets up to 18 cm long.
    5. Leaf blade coriaceous . . . . . 17. *D. elmeri*
    5. Leaf blade herbaceous.
      6. Leaf blade and smaller axes firmer than in the next and spikes less densely set together. . . . . 18. *D. cumingii*
      6. Leaf blade and smaller axes less firm and the latter more densely set . . . . . 19. *D. blumei*
1. Stems as they dry preserving a bright straw colour, firm. Flowers sessile. Fertile stamens 6. . . . . 21. *D. hispida*

#### KEY TO THE SPECIES (♀ plants)

1. Stems as they dry discolouring, indicative of their herbaceous nature.
  2. Plants scarcely coarse. Capsules 2–2½ cm long, completely reflexed at maturity.
    3. Apex of capsule obtuse.
      4. Pubescence short, not very abundant . . . . . 14. *D. tamarisciflora*
      4. Pubescence long and silky, abundant . . . . . 15. *D. pierrei*
    3. Apex of capsule rounded. Plant hirsutely pubescent . . . . . 16. *D. pentaphylla*
  2. Plants coarse. Capsules not less than 2½ cm long, and up to 4½ cm, usually more or less horizontal.
    5. Leaves coriaceous. Capsules rounded above . . . . . 17. *D. elmeri*
    5. Leaves coriaceous or nearly so. Capsules truncate above . . . . . 20. *D. scortechinii*
    5. Leaves herbaceous. Capsules truncate above. (diagnostic characters fail in regard to ♀ plants of the following species) . . . . . 18. *D. cumingii*  
 . . . . . 19. *D. blumei*
1. Stems as they dry preserving a bright straw colour, firm. Capsules large and woody . . . . . 21. *D. hispida*

14. *Dioscorea tamarisciflora* PRAIN & BURK. J. As. Beng. new ser. 10 (1914) 22; R. KNUTH, Pfl. R. 87 (1924) 144; RIDL. Fl. Mal. Pen. 4 (1924) 314; PRAIN & BURK. Gard. Bull. Str. Settle. 4 (1927) 86 with a plate; Ann. R. Bot. Gard. Calc. 14 (1936) 153, pl. 60.—*D. pentaphylla* var. RIDL. Mat. Fl. Mal. Pen. 2 (1907) 81.—Fig. 5h.

Tubers one or two or three, descending from a corm at the surface of the soil, cylindric, to 30 cm long with a hard black cortex studded with short indurated root-bases. Stem to 6 mm in diam. at the base and with a few prickles, with red or dirty white thin pubescence. *Leaves* ternate; petiole equal in length to the middle leaflet; middle leaflet narrowly elliptic, long acuminate, penninerved, to 6 by 2½ cm; base acute; lateral leaflets slightly inequilateral, with one primary nerve in addition to the midrib on each side of it; upper surface of the leaflets with a few hairs, the nerves scarcely

raised, lower with red-brown hairs; petiolules 2–3 mm. Simple leaves may be produced distally and are of small size. *Male flowering axes* usually gathered together on leafless branches which attain 20 cm; axis to 4½ cm, with upwards of 45 flowers closely set except that there are a few bare mm at the base. Pedicel ½–1 mm. Bracts ovate, acuminate, hirsute with white and deep red hairs. Torus not flattened. Outer tepals broadly ovate, very obtuse, less than 1 mm long, pubescent outside. Inner tepals spatulate and thick, glabrous. Stamens ½ mm long, filaments as long as the anthers; staminodes overtopping the anthers. *Female inflorescences* as those of *D. pentaphylla* (see p. 315). Capsules differing in the apex being obtuse; wings 22 by 7 mm (see fig. 5h).

Distr. From Peninsular Siam to *Malaysia*: Malay Peninsula (as far as Johore), rare and local.

**15. *Dioscorea pierrei* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 22; R. KNUTH, Pfl. R. 87 (1924) 144; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 154, pl. 69.**

Tuber stalked and clavate, as much as 130 cm long by 8 cm in diam.; flesh edible. Stem with scattered prickles, abundantly softly pubescent. *Leaves* 3–5-foliate; petiole shorter than the middle leaflet by  $\frac{1}{4}$ , with red-brown hair; middle leaflet elliptic to ovate, moderately acuminate; base acute, pinninerved, to 15 cm long; outer leaflets inequilaterally ovate and smaller than the middle leaflet by  $\frac{1}{4}$ ; upper surface of the leaflets with scattered red-brown rather stiff hairs, lower densely pubescent; petiolules to 5 mm long. *Male flowering axes* on leafless branches which attain 30 cm; axes 1–2 together to 30 mm long, their flowers set touching. Bracts ovate, rather acute, densely pubescent on the back; pedicels  $\frac{1}{2}$  mm. Outer tepals exactly ovate above a broad base, 1 mm long, pubescent outside. Inner tepals narrowly obovate, glabrous, shorter than the outer ones and thick. Stamens as in *D. tamarisciflora*, staminodes overtopping them. *Female flowering axes* decurved, 1–2 together, densely pubescent. Bracts lanceolate to 1 mm long. Outer tepals linear-lanceolate, acute, rather less than 1 mm long pubescent outside, inner ones a little shorter. Pedicels less than 1 mm long, reflexed after pollination. *Capsules* just imbricating, retaining their pubescence to ripeness by which time it is bleached white, subtruncate at the apex, rounded at the base, wings 22 by 7 mm.

Distr. Annam, Cambodia and thence down Peninsular Siam beyond the Isthmus of Kra to the border of *Malaysia*, at Pang-nga in the Circle of Puket.

**16. *Dioscorea pentaphylla* LINNÉ, Sp. Pl. (1753) 1032; ROXB. Fl. Ind. 3 (1832) 806; BLANCO, Fl. Filip. (1837) 802; HASSK. Hort. Bog. (1844) 33; MOR. Syst. Verz. (1846) 92; ZOLL. Syst. Verz. (1854) 68; MIQ. Fl. Ind. Bat. 3 (1859) 574; WARBURG, Bot. Jahrb. 13 (1891) 273; HOOK. f. Fl. Brit. Ind. 6 (1892) 289; QUEVA, Mém. Soc. Sci. Lille IV, 20 (1894) 197, 373; MERR. Rev. Sp. Blanc. (1905) 86; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 80; KOORD. Exk. Fl. Java 1 (1911) 308, Atlas (1923) 259; KOORD.-SCHUM. Syst. Verz. 9 (1912), *genus* 1252; MERR. Fl. Manila (1912) 152; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 23; MERR. Interpr. Rumph. Herb. Amb. (1917) 147; BURK. Gard. Bull. S. S. 2 (1918) 92 with a plate; W. H. BROWN, Bull. 22 Philip. Bur. For. 2 (1921) 258; MERR. En. Philip. Fl. Pl. 1 (1922) 218; HEYNE, Nutt. Pl. Ned. Ind. (1922) 501; R. KNUTH, Pfl. R. 87 (1924) 145 *excl. var. lunata* ROTH; BACKER, Handb. Fl. Jav. 3 (1924) 111 in chief part; RIDL. Fl. Mal. Pen. 4 (1924) 314; OCHSE, Veget. D.E.I. (1931) 255; BURK. Dict. (1935) 822; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 160, pl. 66 & 67 & (1938) 422.—*D. triphylla* LINNÉ, Sp. Pl. (1753) 1032; BL. En. Pl. Jav. 1 (1827) 20; MIQ. *op. cit.* 573 in part.—*D. kleiniana* KUNTH, En. 5 (1850) 394; MIQ. *op. cit.* 573.—*Hamatris triphylla* R. A. SALISBURY, Gen. Pl. Fragm. (1866) 12.—**Fig. 5g, 6c.****

Tuber in some varieties elongated and burying deeply, in others not so and then globose or pyriform, in some cultigens palmately lobed, never stalked, generally coated if short by bristly roots, or if long with such roots on the upper part; flesh white or lemon yellow, sometimes with purple flecks in it, nauseous in the wild plants, though not particularly so if deep burying. *Stem* single, to 7 mm in diam. at the base, climbing to 10 m, and usually abundantly prickly over the lowest internodes, pubescent, but then glabrescent. Bulbils plentiful, globose or shortly ellipsoid, rarely cylindrical, skin brown, flesh yellow. *Leaves* 3–5-foliate; petiole shorter than the middle leaflet by about  $\frac{1}{4}$ , pubescence deep rusty red or dirty white; middle leaflet broadly oblanceolate or obovate, apex shortly acuminate, not glandular, base obtuse or rounded, to 15 by  $4\frac{1}{2}$  cm; outer leaflets inequilateral with one additional primary nerve outside the midrib; leaflets relatively broader when 3 than when 5, pubescent on both surfaces, but soon glabrescent above. Petiolules at most 5 mm. *Male flowering axes* for the most part gathered on leafless branches of considerable size, only rarely axillary; axis to 3 cm long, carrying upwards of 50 flowers placed close together or in contact. Buds appearing to be globose because the bract and bracteole so wrap them as to hide their flat base. Pedicels  $\frac{1}{2}$ –1 mm; bract and bracteole near the apex. Bracts usually broader than long. Outer tepals broadly lanceolate, subacute, pubescent or glabrous at the back, to 1 (– $1\frac{1}{2}$ ) mm long; inner ones rather broader and blunter, glabrous. Stamens inserted at the base of the tepals, the 3 fertile stamens shorter than the staminodes; anthers twice as long as the filament. *Female flowering axes* directed downwards, 1–3 together from a leaf-axil, up to 25 cm long, pubescent, the hairs variable in the intensity of their redness. Tepals as in the male plant. Flower inverted after pollination. *Capsule* blackening somewhat as it ripens, with rounded shoulders about the apex though just retuse at the flower, base usually rounded; wings to 20 by 6 mm, retaining some pubescence until of full size.

Distr. From Upper India through *Malaysia* to the remoter islands of the Pacific (probably carried by man); in Thursday Island but not in Australia. North along the Himalaya (to 1900 m), and across S. China through Yunnan and Kwang-tung to c. 22° N.

Ecol. The climatic requirements of *D. pentaphylla* are almost those of *D. bulbifera*. It is, moreover, like *D. bulbifera* in the quantity of the bulbils that it produces and the freedom with which it seeds; but it has not furnished man as *D. bulbifera* has, with cultigens altered in bulbils, but it has yielded cultigens with the shape of the tuber altered. Fl. N. of the equator Sept.–Oct., S. of the equator April–May.

Taxon. Within its wide range it has a number of varieties, some of them cultigens. The tubers of certain of them are figured in the 'Gardens Bulletin Straits Settlements' and the 'Philippine Agriculturist and Forester'; references to these figures are entered into the following key, cited resp. as *G.B.* and *P.A.*

## KEY TO THE VARIETIES

1. Tubers elongated to more, generally to much more, than twice their diameter (*G.B.* 2, 92); *P.A.* 3, 207). Red pubescence rather abundant, the leaflets rather narrow. . . . *var. malaica*
1. Tubers not elongated to more than twice their diameter and frequently considerably lobed.
2. Tubers not flattened, rooty all over their surface.
3. Large vigorous plant, leaflets to 20 cm long, red pubescent. Flowers large. Distal leaves not uncommonly simple (*G.B.* 3, 258).  
*var. papuana*
3. Smaller plant. Leaflets commonly to 10 cm long. Flowers smaller (*G.B.* 3, 258).  
*var. javanica*
2. Tubers flattened (by fasciation), smooth-skinned. Leaflets rather narrow, rather silvery pubescent.
4. Leaflets to 20 cm long. Flowers relatively large. Tubers (*G.B.* 3, 258; *P.A.* 3, 207) generally larger than in the following.  
*var. palmata*
4. Leaflets to 14 cm long. Flowers smaller than in the above. Tuber (*G.B.* 3, 258) smaller.  
*var. sacerdotalis*

Econ. It has been said that the jungle tribes of the Malay Peninsula seek it more than any other *Dioscorea* (SKEAT & BLAGDEN, Pagan Races 1, 1906, 109); but this seems doubtful as the supplies are small. The high forest shuts it out, and perpetual humidity is unfavourable. To lesser humidity is apparently due a greater abundance N of Penang and in the country behind Malacca. In both parts it is planted in garden fences whence tubers may be dug if required. The variety used is *var. malaica* PRIN & BURK. (J. As. Soc. Beng. new ser. 1, 1914, 23); rather long tubers, the middle leaflet is c. 4 times as long as broad. The Sakai call it *jabet* or *chabet*. Plants of N. Borneo may equally be referred to *var. malaica*.

In a similar way *D. pentaphylla* is planted in garden hedges in other parts of Malaysia, in several varieties. OCHSE (*l.c.*) has given an account of those in Java, describing the tubers of the most usual form as small, cylindrical and unbranched, calling it *huwi sawut* (fibrous yam). With it are more ennobled plants as *huwi jahe* (ginger yam, so named from the shape), which is *var. javanica* BURK. (Gard. Bull. Str. Settl. 3, 1924, 258).

*Huwi sawut* can bear no botanical name at present because the Sundanese and the Javanese do not apply the vernacular name strictly. It occurs in bamboo thickets, on forest margins and in similar places, as well as in garden hedges; in the hedges it has encouragement without cultivation and now and then is dug for food, eaten roast or boiled by itself or in mixed vegetables as a flavouring.

Superior to *huwi jahe* and considerably superior to the average *huwi sawut* is *var. sacerdotalis* BURK. (*l.c.*). It has high sounding names as *huwi mantri* (priest's yam), *huwi putri* (princess' yam) and *huwi dewata* (sacred yam); it has been suggested that they came to denote it because it was a food allowed on Hindu fast days. The foliage of these

Javanese economic varieties is smaller than that of *var. malaica* and the male flowers are small in a degree which makes recognition easy, not of the exact variety for that depends on the tuber, but that one of the group is under the eye.

*Var. sacerdotalis* is recorded from the Res. of Madiun, Pasuruan and Besuki in E. Java and the Kangean Isl. between 1 and c. 1000 m. Its leaflets are broader, in proportion to their length, than those of the wider spread *var. javanica* BURK. (*l.c.*) and not uncommonly there are simple leaves towards the stem-ends. The type was cultivated by K. HEYNE at Bogor, but he did not record whence he obtained it.

*Var. javanica* occurs in Celebes as well as in Java, and would seem to occur through the Lesser Sunda Islands. RUMPHIUS's account of *D. pentaphylla* is interesting (Herb. Amb. 5, 359); he wrote in particular of its uses in Sumbawa, where three kinds occurred. The first he called the white kind; it produced large white-fleshed tubers of which the extremities could be eaten although of vile flavour; the second he called the red kind and it had hard red flesh; it produced smaller tubers and they were better to eat; the third, called the black kind, turned black in cooking and blackened the water in which it was boiled. These cannot as yet be assigned to varietal names.

The Ambonese, RUMPHIUS recorded, would transplant tubers from the forest to their gardens but not much and they would eat the produce of their gardens but not the plant direct from the forest unless driven by famine. The two tubers figured by him (pl. 177), the one lobed, the other clavate, represent respectively the cultivated and the wild plant.

The above references do not dispose entirely of the forms of the species in SE. Malaysia, for FORSTEN collected in Bima (Sumbawa Island) a very graceful plant which has not been seen from elsewhere.

In the Philippines there are at least two varieties: one may be referred to *var. malaica* BURK., the other has been named *var. palmata* BURK. (*l.c.*); it is a cultigen close to *var. sacerdotalis*, but larger in tuber. A plant appearing to be *var. palmata* has been collected in Timor.

In New Guinea there is a very robust *var. papuana* BURK. (*l.c.*) with a remarkably prickly stem up to 12 mm in diam. and so large as to have paired scale-leaves at the base. Can it be *D. globifera* R. KNUTH which otherwise remains unplaced?

Vern. A few names which suggest transference within Malaysia from one place to another doubtless originates with the adoption of a cultivated race. A name recorded by RUMPHIUS for Ternate is *ubi pariaman* suggesting transference from Priaman in NW. Sumatra. Another place-name *ubi magindano* meaning yam of Menado, is in use in N. Celebes. Various descriptive names under *ubi* and *huwi* have been mentioned under Economy. It is very interesting to record that the name *jabet* used by the Central Sakai of the Malay Peninsula has been obtained by BACKER in central Java and in this connection to point out the similarity of *jabet*

to *rabet* used in Madura. Immediately E of Java the name changes, and is *samoan*, *samowan*, *samwan* and *susuan*. Again to the E, in the Moluccas, it is *iwel*, *aywel*, *iae* or *ahei*; and it is *lae*, *lahi* or *lua*, and besides there are not fewer than ten other names, the currency of which are not well enough vouched for as yet.

**17. *Dioscorea elmeri* PRAIN & BURK.** in ELMER, Leaflet. Philip. Bot. 5 (1913) 1594; J. As. Beng. new ser. 10 (1914) 24; MERR. En. Philip. Fl. Pl. 1 (1922) 216; R. KNUTH, Pfl. R. 87 (1924) 147; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 180, pl. 70.—Fig. 5i.

Underground parts unknown. Stem thicker than that of *D. pentaphylla* and of greater growth. Leaves harsh, 3–5-foliolate; petiole shorter than the middle leaflet by about  $\frac{1}{4}$ ; middle leaflet ovate or elliptic-ovate, very shortly acuminate, to 13 by 7 cm, base obtuse; outer leaflets very inequilateral, with one primary nerve outside the midrib; upper surface glabrous at maturity, lower with abundant rusty red hairs on the larger nerves. Male plant uncertain. Female flowering axes solitary or 2 together from the axils of upper leaves, decurved, to 20 cm long and then bearing c. 40 capsules, densely red-brown pubescent. Bracts broadly ovate, to 2 mm. Pedicel after pollination turning the fruit upwards. Outer tepals lanceolate-ovate, acute, densely covered outside by red-brown hair, inner ones similar, but less pubescent. Capsules chestnut-coloured, rounded at both ends, but variable in the evenness of rounding at the base, appearing to be a little uncertain in the way of dehiscence; wings 25 by 10 mm.

Distr. Malaysia: Philippines (Luzon, S of Manila).

Ecol. Everwet forests to 800 m.

**18. *Dioscorea cumingii* PRAIN & BURK.** J. As. Soc. Beng. new ser. 4 (1908) 449; *ibid.* 10 (1914) 25; MERR. En. Philip. Fl. Pl. 1 (1922) 216; R. KNUTH, Pfl. R. 87 (1924) 148; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 182, pl. 73.—*D. inaequifolia* ELMER ex PRAIN & BURK. in ELMER, Leaflet. Philip. Bot. 5 (1913) 1595; J. As. Soc. Beng. new ser. 10 (1914) 24; R. KNUTH, *op. cit.* 146; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 181, pl. 71.—*D. polyphylla* R. KNUTH, Pfl. R. 87 (1924) 148; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 184, pl. 74.—*D. echinata* R. KNUTH, Pfl. R. 87 (1924) 148.—Fig. 5j.

Underground parts unknown. Stem to 10 mm in diam. at the base and decidedly prickly. Leaves 5–9(–10)-foliolate; petiole  $\pm$  as long as middle leaflet; middle leaflet lanceolate to ovate-elliptic or elliptic, acuminate in varying degree, acute at the base, to 18 cm long; outer leaflet inequilateral, the less so the more numerous the leaflets, even to being almost equilateral, acuminate in varying degree; leaflets herbaceous, glabrescent above, pubescent below though tending to lose the hairs which are of a red colour passing to a dirty white; petiolules to 10 mm. Male flowering axes collected into large leafless branches to 70 cm long, usually

2 together, sometimes more, one considerably larger than the others; flowering axes to 3 cm, generally with red-brown hairs, flowers their own diameter apart; pedicels  $\frac{1}{2}$  mm; bracts 1 mm long wrapping over the buds incompletely. Outer tepals ovate, acute, glabrescent, 1 mm long, inner ones smaller, subspathulate, obtuse and curved inwards slightly. Stamens inserted at the base of the tepals, filaments as long as the anthers, the 3 staminodes overtopping the anthers. Female flowering axes solitary or paired, downwardly directed from the axils of upper leaves; axis angled, pubescent, with upwards of 30 flowers. Bracts lanceolate-ovate, acuminate, 2–3 mm long. Pedicels turning the ovaries so as to be horizontal or slightly ascending. Capsule darkening somewhat as it ripens, truncate above or very obtuse, truncate or even retuse at the base, sides rather straight, wings to 36 by 12 mm.

Distr. Malaysia: throughout the Philippines.

Taxon. Variable and divisible into the following varieties:

#### KEY TO THE VARIETIES

1. Capsule to 30 mm long.
2. Leaflets to 7, more or less ovate.
3. Pubescence moderately abundant, rusty red.  
*var. inaequifolia*
3. Pubescence dense, of matted white or whitish hairs . . . . . *var. cumingii*
2. Leaflets to 9 (–11), linear-lanceolate or lanceolate . . . . . *var. polyphylla*
1. Capsule to 40 mm long . . . . . *var. ramosii*

The first and the third of these are respectively *D. inaequifolia* ELMER and *D. polyphylla* R. KNUTH, here reduced to varieties, the last, *var. ramosii* BURK. has not been described hitherto unless it is synonymous with *D. heptaphylla* SASAKI (Trans. Nat. Hist. Soc. Formosa 21, 1931, 47; for a comment on SASAKI's description see Ann. R. Bot. Gard. Calc. 14, 1938, 423), which was obtained in the island of Botel Tobago, or Koto sho, which is 80 km E of the southern point of Formosa. *Var. ramosii* has been obtained in both sexes on the slopes of Mt Iraya in the island of Batan (RAMOS 79927, 79946) and on Camiguin Volcano in the island of this name (EDAÑO 79173). These islands are between Luzon and Formosa.

*Var. polyphylla* (R. KNUTH) BURK., which by reason of its many leaflets appears more distinct from the other components of *D. cumingii* than it really is, occurs from the N. parts of Luzon to the latitude of Manila, whence southwards *var. inaequifolia* (ELM.) BURK. replaces it. Near the boundary between these two the type of *var. cumingii* was obtained, at an unspecified locality in the Province of Batangas (CUMING 1469).

Ecol. The usual habitat of *D. cumingii* is about the skirts of mountains where the rainfall is considerable.

Econ. ELMER recorded that parts of the tuber, obviously the lower parts, are eaten as food in the Province of Benguet, Luzon. He gave to it the Igorot name *kasi*. *Pari* is said to be its name in the Bagobo language of Mindanao. Townsfolk who do not need to eat tubers of *D. pentaphylla* and its

immediate allies do not distinguish it from *D. pentaphylla* and call both by the factitious name *limailima* (the fives) from the usual five leaflets.

**19. *Dioscorea blumei* PRAIN & BURK.** J. As. Soc. Beng. new ser. 10 (1914) 25; R. KNUTH, Pfl. R. 87 (1924) 149; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 185, pl. 75.—*D. pentaphylla* (non L.) BLUME, En. Pl. Jav. (1827) 20; BACKER, Handb. Fl. Jav. 3 (1924) 111 in small part.—Fig. 6b.

Underground parts and lower parts of the stem unknown; distal parts glabrous (doubtless glabrescent), sparingly prickly, faintly ridged. Bulbils none seen. *Leaflets* 5, thinly herbaceous; petiole c. 7 cm, sparingly clad with rather stiff hairs; middle leaflet elliptic, obtuse or almost rounded at the base, abruptly acuminate, to 12 by 5 cm; outer leaflets only slightly inequilateral; upper surface of the blades glabrous; lower retaining to maturity a small amount of rusty red hair; nerves prominent; petiolules to 10 mm. *Male inflorescences* up to 50 cm long, the primary axis branched and the branching twice or thrice repeated, shortly pubescent, ultimately glabrescent. Bracts carried almost at the top of the pedicel which is 1 mm long, broadly triangularly ovate,  $\pm$  acuminate, rusty red haired. Flower-bearing axes to 2 cm long so densely placed that they touch one another. Outer tepals ovate, obtuse, bordered and beset down the middle line by red-brown hairs  $1\frac{1}{2}$  mm long, inner ones elliptic, shorter than the outer ones, obtuse. Stamens overtopped by the staminodes. *Female plant* unknown.

Distr. *Malaysia*: W. Java (Mt Salak, S of Bogor); collected by REINWARDT, and not collected since. Also in N. Sumatra?

Notes. LINNÉ had made two *spp.*: *D. pentaphylla* and *D. triphylla* on closely similar material, and BLUME identified the more vigorous part of his material with the first, and the less vigorous plants with the latter.

A  $\sigma$  plant similar to REINWARDT's has been obtained in N. Sumatra (at Sibolangit, LÖRZING 4816, 4817), well-collected except the tuber; base of stem 12 mm diam., paired scale-leaves at the base, leaves 3–7-foliolate, middle leaflet 28 by 10 cm. It is likely that the base of REINWARDT's specimen was as large. If it be, as is probable, that the Javan and Sumatran specimens belong to the same species, there is a reasonable possibility that in both places a polyploid condition has been thrown by local *D. pentaphylla*. If so, is *D. cumingii* an established polyploid?

HAINES (Fl. Bihar & Orissa 1925, 1123) has suggested that the Indian *D. kalkapershadii* PRAIN & BURK., a larger plant than *D. pentaphylla*, is a polyploid. It is desirable that the chromosome numbers should be taken of any giant specimens resembling *D. pentaphylla*.

**20. *Dioscorea scortechinii* PRAIN & BURK.** J. As. Soc. Beng. new ser. 4 (1908) 455; *ibid.* 10 (1914) 25; R. KNUTH, Pfl. R. 87 (1924) 149 in part; RIDL. Fl. Mal. Pen. 4 (1924) 314 in part; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 186, pl. 76, *ibid.*

(1938) 424.—*D. pentaphylla* (non L.) RIDL. & CURTIS, J. Str. Br. R. As. Soc. 38 (1902) 66 in part.—Fig. 5o.

Tuber pyriform to clavate; flesh firm. Stem abundantly prickly at the base, to 6 mm in diameter, from pubescent to glabrescent. *Leaves* 3–5-foliolate, herbaceous; petiole about as long as the middle leaflet, glabrous; middle leaflet elliptic, acuminate, acute at the base, to 8 by 4 cm, outer leaflets inequilateral with one primary nerve outside the midrib; blades below with short red-brown hair, nerves prominent; petiolules to 5 mm. *Male flowering axes* aggregated into long leafless inflorescences, 1–4 together; flowers to 25 on the flower-bearing axes 5 cm long, touching each other, pubescent with red-brown hair. Bracts narrowly ovate, acuminate, covering but not enveloping the flower, densely pubescent,  $1\frac{1}{2}$  mm long. Pedicels carrying the bract close under the flower. Outer tepals ovate, acute, 1 mm long; filament as long as the anther; staminodes subspathulate, overtopping the stamens. *Female flowering axes* solitary from the axils of upper leaves, with c. 35 flowers buried in red-brown hair but later glabrescent. Bracts lanceolate, acute, densely pubescent,  $1\frac{1}{2}$  mm long. Fertilized ovary in a horizontal position. Outer tepals broadly ovate, acute,  $1\frac{1}{2}$  mm long, densely pubescent outside, inner ones similar except thinner margins. *Capsules* blacken as they ripen, slightly retuse at either end, margins parallel; stipe 2 mm; wings 40–50 by 11–12 mm.

Distr. Tonkin (a variety), *Malaysia*: Simalur Island, N. Sumatra, Malay Peninsula (from Perak southwards).

**21. *Dioscorea hispida* DENNSTEDT, Schlüss.** Hort. Malab. (1818) 15; MERR. Interpret. Rumph. Herb. Amb. (1917) 148; Sp. Blanc. (1918) 103; En. Philip. Fl. Pl. 1 (1922) 217; HEYNE, Nutt. Pl. N.I. (1922) 498; BACKER, Handb. Fl. Jav. 3 (1924) 110; PRAIN & BURK. Kew Bull. (1927) 237; OCHSE, Veget. D.E.I. (1931) 250; BURK. Dict. (1935) 818; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1936) 188, pl. 77 & 78.—*D. triphylla* (non LINNÉ, Sp. Pl.) LINNÉ, in STICKMANN, Herb. Amb. (1754) 23; AMOEN. Ac. 4 (1754) 131; JACQ. Ic. Pl. Rar. 3 (1790) 627; GMEL. in LINNÉ, Syst. Nat. ed. 13, 1 (1791) 481; BLANCO, Fl. Filip. (1837) 799; PRAIN & BURK. in ELMER, Leaf. Philip. Bot. 5 (1913) 1595; J. As. Soc. Beng. new ser. 10 (1914) 25; WESTER, Philip. Agr. Rev. 9 (1915) 173; RIDL. Fl. Mal. Pen. 4 (1924) 314; R. KNUTH, Pfl. R. 87 (1924) 131; ORR, Not. R. Bot. Gard. Edinb. 15 (1926) 136.—*D. hirsuta* DENNST. *op. cit.* 33; BLUME, En. Pl. Java 1 (1827) 21; MOR. Syst. Verz. (1846) 92; MIQ. Fl. Ind. Bat. 3 (1859) 575; WARB. Bot. Jahrb. 13 (1891) 273; GRESHOFF, Med. 's-Lands Plantentuin 10 (1893) 151; KOORD. *ibid.* 19 (1898) 312; GRESHOFF, Med. Dep. Landb. 3 Suppl. (1913) 28.—*D. mollissima* BLUME, En. Pl. Java 1 (1827) 21; MIQ. *op. cit.* 574.—*D. daemona* ROXB. Fl. Ind. 3 (1832) 805; HOOK. f. Fl. Br. Ind. 6 (1892) 289; RIDL. & CURT. J. Str. Br. R. As. Soc. 38 (1902) 66; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 80; WATT, Comm. Prod. Ind. (1908) 494; KOORD. Exk. Fl.



Java 1 (1911) 308.—*Helmia hirsuta* KUNTH, En. Pl. 5 (1850) 438; QUEVA, Mém. Soc. Sc. Lille IV, 20 (1894) 193, 381.—Fig. 5k-n, 6c.

Tuber in a general way globose, but lobed, occasionally slightly elongated, up to 35 kg or even more, straw-coloured to light grey outside, produced at the surface of the soil and intensely poisonous, flesh white to lemon yellow. Stem to 9 mm in diam. or more, usually prickly, green to straw-coloured, at first pubescent, then glabrescent. Bulbils never seen. *Leaves* 3-foliate; petiole as a rule rather longer than the middle leaflet, to 25 cm long, frequently with small prickles on the larger nerves at the back; middle leaflet elliptic or elliptic-oblong, rarely obovate, still more rarely tri-partite, acuminate, acute at the base, to 30 by 28 cm; lateral leaflets inequilateral, the outer half 3-nerved; blade herbaceous in the Indian *var. daemona* (ROXB.) PRAIN & BURK. (1934), more or less chartaceous in the varieties of Malaysia particularly in *var. reticulata* (HOOK. f.) PRAIN & BURK. (1927) upper surface thinly silky when young, then glabrous, with all the nerves conspicuous; lower surface retaining its hairs to some extent; petiolules to 10 mm. *Male flowering axes* gathered into large leafless inflorescences twice or thrice compounded, sometimes 50 cm long; axes bearing the flowers usually solitary, with upwards of 40 flowers which are closely packed in *var. daemona*, but spaced in the other varieties, clothed in tawny or white hairs [*var. mollissima* (PRAIN & BURK.) PRAIN & BURK. (1927)]. Bracts just overtopping the flowers, subsaccate and acuminate, pubescent at the back. Outer tepals orbicular, very thin at the margin, pubescent on the back at the middle,  $\frac{3}{4}$  mm diam., inner ones a little longer and firmer, incurved. Stamens all fertile,  $\frac{1}{2}$  mm long, anther as long as the filament. *Female flowering axes* solitary from upper leaf axils, downwardly directed, when capsules are mature pendulous by their weight. Flowers spaced. Bracts triangularly lanceolate, pubescent, 2–2½ mm long. Fertilized ovaries and capsules facing more or less upwards. Outer tepals ovate-lanceolate, pubescent, inner ones a trifle smaller. Capsules becoming glabrous, honey-coloured, imbricating, apex obtuse in various degrees, base variable and at times one wing may be more truncate than another (fig. 6e); sometimes the wings are retuse at the base about the stipe; wings broadest above the middle, to 40–50 (–60) by 10–12 mm, their margin sometimes freed in dehiscence and looking like a fine wire. Seeds winged to the base of the cell.

Distr. W. India through *Malaysia* to W. New Guinea, also in New Ireland. As it is cultivated to some extent, the occurrence in New Ireland and N. Guinea may be due to man.

#### KEY TO THE VARIETIES

1. Male flowering spikes dense, flowering terminal part not more than twice as long as thick; foliage more herbaceous than chartaceous.  
*var. daemona*
1. Male flowering spikes considerably longer and the flowers barely touching each other.

2. Vigorous plants with capsules truncate or even retuse at the apex.

3. Hairs honey-coloured . . . *var. hispida*

3. Hairs white denser as a rule *var. mollissima*

2. Less vigorous plants with much smaller almost acute capsules . . . *var. scaphoides*

*Var. hispida* is universal in Malaysia. *Var. mollissima* is reported to occur in various localities from Burma to Java, and always in country where *var. reticulata* occurs. *Var. scaphoides* PRAIN & BURK. (1927) occurs in Siam and southwards down Peninsular Siam to the Circle of Phuket. *Var. daemona* has been reported from various localities within Malaysia but all these need verification, because the determination has depended on imperfect herbarium material. The undisputed distribution of *var. daemona* is from the Bombay coast to the western edge of Burma. LINNÉ confused *D. hispida* with *D. pentaphylla* under the name *D. triphylla*; and when JACQUIN figured it calling it *D. triphylla* his very excellent figure went far towards fixing that name. But DENNSTEDT put forward two names for it in 1818 and one of them *D. hirsuta*—it stood second in order of pages—BLUME took for it and led a school which employed it. ROXBURGH had already issued *D. daemona*. Botanists in India became divided, some following BLUME and some ROXBURGH. MERRILL in 1917 showed that by rule DENNSTEDT's first name, *D. hispida*, is the correct one. Writers on African plants confused the African *D. dumetorum* PAX; and the circumstance has this of interest in it that, whereas *D. hispida* is the chief famine food of tropical Asia, *D. dumetorum* takes the same position in a large part of tropical Africa (see CORKILL, Ann. Trop. Med. 42, 1948, 278).

Econ. *D. hispida* owes its importance in famine to the comparative ease with which it surface-growing tubers can be gathered, and to their size which goes far towards relieving a situation of distress. After harvesting follow days of preparation during which the poisonous alkaloid, *dioscorine*, must be washed out of the tissues by water. The process entails a killing of the tissues in which slicing, pounding, rasping and boiling may be used in various ways; then must follow days of soaking in water, sea water or water with salt in it being best. The final product is a starchy meal which can be made into palatable preparations and moreover will keep if dried and kept dry. The alkaloid is present in the foliage as well as in the tuber. A piece of the raw tuber of the size of an apple kills a man. A proverb of the Island of Roti runs—'he who eats *boti* (the local name for the tuber) must die'. Pounded tubers are used in India for poisoning bait for tigers. All mammals are susceptible and beyond all doubt the plant is very well protected in the forests. In many countries it is customary to prepare the meal, though in most of them to use it only when there is scarcity; but Hindu priestly law permitted the eating on fast days (*cf.* under *D. pentaphylla*). It would seem that *D. hispida* is planted in Java more than elsewhere; but it has not been demonstrated that a race less poisonous than



the wild plant is employed. Malays who made palm sugar from *Arenga* formerly encouraged it because they employed pounded tubers as a paste to keep sterile the wounds of their tapping. This accounts

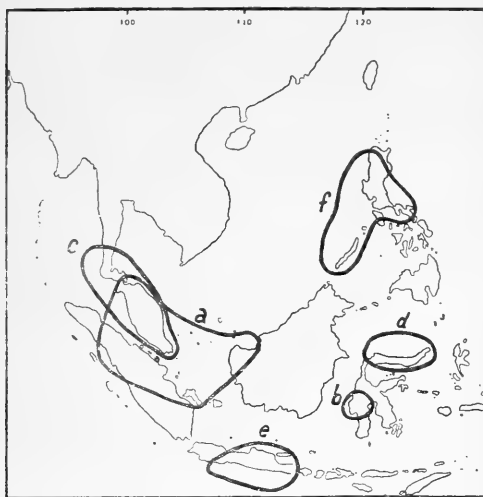


Fig. 9. Distribution of the species of § *Enantiophyllum* which have negative geotropism in the male flowering axes: a. *D. laurifolia* WALL. ex HOOK., *D. bancana* PR. & B., and *D. havilandii* PR. & B. taken together, b. *D. vanvuureonii* PR. & B., c. *D. prainiana* KNUTH, d. *D. warburgiana* ULINE ex KOORD., e. *D. vilis* KUNTH, f. *D. luzonensis* SCHAUER and *D. peperoides* PR. & B. taken together.

for an unusual abundance about villages near Malacca; and for a like abundance which exists no longer but was observed by RIDLEY in Singapore Island (see J. Str. Br. R. As. Soc. 33, 1900, 167).

Vern. There is a Mon-Khmer word *khoei* for yam, converted everywhere in Burma to *kywe* and restricted by the Burmese to *D. hispida* which appears on the tongues of the Northern Sakai and Ple-Temiar of the mountains between Perak, Kelantan and Pahang in the form *kuai*. It is not used by those who live in the lowlands whose noun for *D. hispida* is the unlike word *gadong*. *Gadong*—*gadung* in Java—is wide-spread; it is used in Sumatra, the Malay Peninsula, Borneo, and by the Bugis of Celebes, through Java and down the Lesser Sunda Islands at least to Sumbawa where it loses its terminal *ng* and becomes *gadu*. It is known to the Northern Sakai, along with *kuai*, and recorded from them as *gadog*. It invariably indicates *D. hispida*, but the Battaks of Sumatra extend it, with qualifications, to other *Dioscoreas*. It is a well defined name, as befits a plant of considerable importance. In the northern parts of the Philippines *D. hispida* is widely named by a noun commencing with *k*: *karut*, *karot*, *kadut* and *kayos*, passing to *orot*, *orkot* and *gayos*. Among the Tagalog of Luzon, curiously the Spanish word *nyami* has been taken into use for it in the form *nami*. One would doubt the origin were it not that another Spanish word, *sarsaparilla*, has been adopted in the Sambali language (see below under § *Enantiophyllum*). In Bali and on the opposite coasts of Celebes *D. hispida* is named *sikapa*, *siapa*, *sikapang* or *sikapu*. In Bali *yangga* and *diangga* are also used. In Roti and Timor, *boti* and *botil* are used, but cover also *D. bulbifera*. There is another name in Timor, *kasimun*.

About the Alfura Sea the following names are known: *butule*, *hayule*, *hayuru* or *hayuro*. *Ondo* or *ondot* occur in Ceram and Amboyna. *Lede* is reported from Bima in Sumbawa; *lei* from the Serwatti Islands (near Timor), and from the Kei Islands; and lastly *mamo* in the Bikol language of Mindanao and *bagai* in the Mangyane language of Central Mindoro.

## 7. Section *Enantiophyllum*

ULINE in E. & P. Nachtr. (1897) 87; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 8; R. KNUTH, Pfl. R. 87 (1924) 257; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 211.—Fig. 4c–f, 5p–r, 6d–f, 9–14.

Tubers 1 or sometimes 2 or more, usually deeply descending into the soil, annually replaced, never poisonous though sometimes unpleasant to eat, chiefly from tannins and saponins. Stem twining to the right, usually armed, particularly at the base. Hairs usually absent, if present as stiletto hairs (fig. 6) or dendroid hairs. Extra-floral nectaries of the deep kind. *Leaves* entire, opposed or alternate; on thin axes alternate, on axes thicker at origin opposite; petiole not auriculate at the base. *Male flowers* in spikes axillary or more generally cauliflorous. Flower fleshy, particularly the torus (fig. 4e–g), the latter not enlarging into a cup, in some *spp.* of Celebes growing upwards; tepals incurved through anthesis so that the flower scarcely expands; outer tepals ovate,  $\frac{3}{4}$ –2 mm, inner ones narrower at the base and  $\pm$  shorter and blunter. Filaments as long as the introrse anthers. Bract repressed against the axis and curving round the bud, not so in ♀ fls; bracteole inserted within

one margin of it. *Female flowering axes* decurved, 1 to 3 together from a leaf axil; flowers and capsules facing forward; wings of the capsules as broad as or broader than long; stipe growing proportionately with the ripening capsule. Seeds winged all round with a smoky brown, membranous wing conform to the loculus, of 2–3 cm diam.

Distr. The *Enantiophylla* make a compact group of species often difficult to discriminate, spread through the tropics of the old World from the Atlantic to the Pacific.

Ecol. Most of them protect their tubers by deep burial in the soil. One species which does not bury deeply has much tannin in its tubers and a few others have thorny roots; but none of these are Malaysian. Some hold saponins. Man uses the tubers of almost every one for food when circumstances make the labour of digging them up worth while. He created *D. alata* as a cultigen taking advantage particularly of such variations as it produced towards shallow burying, perpetuating the variations in clones. In Malaysian *Enantiophylla* largeness of lamina and presence of hairs are associated characters; the species possessing hairs are placed at the end of the taxonomic sequence adopted here. None of the hairy species pass into Malaysia eastwards of Borneo and Java, and hairiness is absent except that *D. merrillii*, a local species of the Philippines, has a few hairs (fig. 13d).

The commonest species of the section in W. Malaysia is the hairy *D. pyrifolia*, in contrast the commonest species to the eastward, is the glabrous *D. nummularia*.

The distribution in Malaysia of species with narrow leaves is illustrated in fig. 11. The intensive negative geotropism of the male flowering axes (fig. 4c) has been used to bring the species that have it together at the commencement of the sequence. This character is not met with outside Malaysia except slightly in western Africa. *D. laurifolia* and several others have strongly benzoin-scented flowers. This species is used again (fig. 10) to illustrate the dissimilarity of seedling and mature leaves. Female plants possess fewer useful taxonomic characters than male plants. The capsules vary in size as shown in fig. 5 (lowest line, where p is the largest of Malaysia and r the least).

Vern. Every villager in Malaysia distinguishes by name *D. alata* from all the wild species of *Enantiophyllum* as definitely as he distinguishes *D. esculenta*, *D. hispida*, *D. bulbifera* and *D. pentaphylla*, but he does not distinguish consistently the wild *Enantiophylla* one from another, nor from the genus *Smilax*. Often for instance, those who speak Sundanese will give the name as *chanar* or *banar* (that is *Smilax*), adding a qualifying word. Curiously the resemblance to *Smilax*, which is genuine, has introduced into the Sambali language of Luzon the Spanish word *sarsaparilla*, by application to *D. nummularia*, in the form *sapsapariliya*. Malays classify the wild *Enantiophylla* as *akar* (climber) with a qualifying word such as *keminiyan* (benzoin)—e.g. *akar keminiyan* or climber with benzoin-scented flowers. Javanese substitute *aroi* for *akar*. *Kemhang*, recorded as a Semang name is a distortion of *keminiyan*. It is not unusual to cut the tough stems to serve as cordage, whence the Malay word *tali* (cord) may take the place of *akar*. It is recorded as used in the Malay Peninsula, Ambon, and eastern New Guinea. RUMPHIUS used it for *D. nummularia* as *tali cupang* which he translates penny cord, cord strung with coins or mussel shells (the leaves); RUMPHIUS's further names, *daun keping-keping* and *daun pitis-pitis*, may be translated coin-leaved. RUMPHIUS goes on to explain that there is an acrid juice in the stem which irritates the skin and gives rise to the name *daun bisol* (boil leaf). The tubers hold the same juice; but it does not prevent the wild pigs from eating them.

Names for the wild *Enantiophylla* in the Philippines are of more than one series; it is not obvious why this is so. The series are (i) *dulian*, *durian*, *duwiyen*, *duyan*; (ii) *kiroi*, *kiru*, *kwiroi*, *kwiru*, *kwireot*, *kirini*, and (iii) *ubag*, *kobag*. These are used in the several languages of eastern Luzon from the northern end down to Manila for *D. luzonensis*, *D. divaricata*, *D. nummularia*, etc. In Javanese the following names belong to the wild *Enantiophylla* of that island: *weru*, *werung*, *kerung*, *werungan*, *wirung*, *gadungan*. *Waru* used in Ambon seems to be of the group.

KEY TO THE SPECIES<sup>1</sup>

1. Male flowering spikes negatively geotropic (fig. 4c).
2. Male flowers carried on leafless branches. Blades of contemporaneous leaves not cordate at the base.
3. Blade very coriaceous.
4. Blade ovate to broadly elliptic, rounded under the acumen . . . . . 22. *D. havilandii*
4. Blade ovate and narrowed into the acumen . . . . . 23. *D. bancana*
3. Blade coriaceous, ovate and narrowed into the acumen, 10 by 5 cm . . . . . 24. *D. laurifolia*
3. Blade herbaceous, to 15 by 7 cm . . . . . 25. *D. prainiana*

(1) It is impossible to construct a key for the determination of female plants of the section *Enantiophyllum*; they do not exhibit adequate characters.

NAVES introduced the names of several species of the *Enantiophylla* into his *Novissima Appendix* (1880) which are most unlikely to occur in the Philippines, and as his material was destroyed in 1899 in the burning of the Guadeloupe convent at Manila, all that can be done towards elucidation is to enumerate them among the 'excludendae'.

2. Male flowers in fascicles in leaf-axils. Blade in some *spp.* rounded at the base, in others auricled.
  5. Blade coriaceous.
    6. Blade to 17 by 10 cm. Male spikes to 20 cm long . . . . . 26. *D. warburgiana*
    6. Blade to 4 by 2 cm. Male spikes to 5 cm long . . . . . 27. *D. vanvuurenii*
  5. Blade herbaceous.
    7. Blade lanceolate or long-lanceolate . . . . . 28. *D. vilis*
    7. Blade cordate.
      8. Male flowers relatively small, the sepals 1 mm long. Auricles of leaves generally rounded.
        8. Male flowers twice as large. Auricles of leaves angled . . . . . 29. *D. peperoides*
        8. Male flowers twice as large. Auricles of leaves angled . . . . . 30. *D. luzonensis*
  1. Male flowering spikes positively geotropic, carried in fascicles in leaf-axils or towards the ends of weakening stems in the axils of bracts that replace the leaves . . . . . 31. *D. tenuifolia*
  1. Male flowering spikes but little influenced by geotropism.
    9. Torus in the male flower growing upwards centrally, causing the petals and stamens to appear connate or adnate (fig. 4e).
      10. Male flowering spikes in large axillary fascicles . . . . . 32. *D. sarasinii*
      10. Male flowering spikes 1 or 2 together along compound flowering branches . . . . . 33. *D. sexrimata*
    9. Torus in the male flower not growing upwards centrally.
      11. Spikes distributed among the foliage leaves, arising direct in their axils.
        12. Blade ovate. Fascicles of spikes small . . . . . 34. *D. oryzetorum*
        12. Blade lanceolate or linear-lanceolate. Fascicles of 1-3 spikes.
          13. Male flower bud warted at the base inwards in the axil (fig. 4g). Blade very thin.
            13. Male flower bud not warted.
              14. Blade very thin . . . . . 34. *D. oryzetorum* var. *angustifolia*
              14. Blade harsh to coriaceous.
                15. Buds of male flowers globose . . . . . 36. *D. elegans*
                15. Buds of male flowers elongated . . . . . 37. *D. moultonii*
        11. Spikes produced on leafless branches.
          16. Leafless branches small; spikes of unequal sizes. Leaves very coriaceous. Stems very woody.
            16. Leafless branches shorter in general than the axillant leaves, the spikes not showing irregularity in length, but diminishing as the leaf diminishes with its distance from the base of the branch.
              17. Blade at least 4 times as long as broad.
                18. Leafbase just cordately auricled; lower side dull. Capsules relatively small . . . . . 39. *D. calcicola*
                18. Leafbase rounded; lower side bright. Capsules relatively large . . . . . 40. *D. grata*
              17. Blade broadly ovate, acumen long . . . . . 41. *D. opaca*
              17. Blade cordate large, abruptly acuminate . . . . . 42. *D. wallichii*
        16. Leafless branches well developed, as a rule much longer than the axillant leaves. Spikes maintaining a uniform length (but unknown in *D. madiunensis*).
          19. Hairs absent.
            20. Leafbase obtuse or rounded on mature plants (youth forms possess auricles).
              21. Capsule of large size, wings reaching 27 by 30 mm . . . . . 43. *D. madiunensis*
              21. Capsule smaller, wings to 22 by 25 mm.
                22. Blade very thin, drying a deep purple-brown . . . . . 44. *D. sitamiana*
                22. Blade thinly coriaceous, usually rounded at the base, not turning brown.
                  23. Blade exactly ovate . . . . . 45. *D. nieuwenhuisii*
                  23. Blade large and long, to 20 by 5 cm . . . . . 46. *D. kingii*
                  23. Blade small and elongated, to 10 by 2½ cm . . . . . 47. *D. salicifolia*
        20. Leafbase auriculate.
          24. Axis of male spike zigzag.
            25. Stem cylindric. Auricles at the base of the lamina usually with the inner margin bayed about the petiole . . . . . 48. *D. filiformis*
            25. Stem quadrangular with a wing on each angle. Auricles not bayed towards the petiole.
              24. Axis of male spikes not zigzag. Stem if not cylindrical, yet almost so.
                26. Leafbase with rounded auricles.
                  27. Leaf and capsules drying a red-brown. Blade in general a little shorter than that of the species which follow . . . . . 50. *D. nummularia*
                  27. Leaf and capsules inclined to be glaucous green when dry. Blade in general rather longer than in the last . . . . . 51. *D. glabra*
                26. Leafbase with divaricate auricles and the margin between the auricle and the apex rather straight.
                  26. Leafbase subtruncate, and blade somewhat hastate in consequence . . . . . 53. *D. loheri*
        19. Hairs present on at least some part of the plant, particularly on petiole and inflorescences.

28. Blade ovate-elliptic.  
 29. Blade thinly coriaceous. Hairs only on the flowering branches . . . . . 54. *D. merrillii*  
 29. Blade herbaceous. Pubescence on the petioles, backs of leaves in their lower parts, and inflorescences.  
 30. Capsule wings not much wider than semicircular, to 18 by 22 mm. . . . . 55. *D. pyrifolia*  
 30. Capsule wings broader than semicircular, to 21 by 22 mm . . . . . 56. *D. platycarpa*  
 28. Blade cordate. Pubescence more extensive and in *D. orbiculata* dendroid as well as stiletto hairs.  
 31. Leaf margin hyaline. Male flowers nearly or quite in contact one with another, not pubescent outside . . . . . 57. *D. puber*  
 31. Leafmargin not hyaline; male buds pubescent outside.  
 32. Male flower buds not in contact, the spikes long. Upper surface of the leaf glabrous. . . . . 58. *D. orbiculata*  
 32. Male flower buds usually close packed, spikes short. Leaf hairy on both sides 59. *D. polyclades*

22. *Dioscorea havilandii* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 40, excluding the Banka specimen; R. KNUTH, Pfl. R. 87 (1924) 281; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 220, pl. 86.

Tuber unknown. Stem glabrous, wiry, probably unarmed throughout. Bulbils none seen. *Leaves* alternate, decidedly coriaceous, elliptic or the larger so broad as to be almost circular, sometimes ovate [var. *ovalifolia* PRAIN & BURK. (1938)], abruptly acuminate (acumen to 10 mm), base just cordiform, to 11 by 9 cm, 5-nerved, the outermost nerves submarginal and the intermediate much nearer to the margin than to the midrib; upper surface somewhat shining, the larger nerves just prominent after the leaf has been dried; petiole  $\frac{1}{3}$  the length of the lamina. *Male flowering axes* gathered into large leafless branches up to 70 cm long, the axes directed strictly upwards and flowerless through 2-5 mm at the base, then fertile with about 40 flowers, angled. Buds globose, up to 1 mm long. *Female flowering axes* to 35 cm and probably at times longer. *Capsules* broader than in the species immediately following; wings to 20 by 22 mm, apex retuse, base subtruncate.

Distr. *Malaysia*: Borneo (Sarawak and Kutai) and Billiton. Fig. 9a.

Ecol. Mountain ridges, near Kuching apparently common.

Vern. *Akar kowat* (Kuching).

23. *Dioscorea bancana* PRAIN & BURK. Kew Bull. 1925, 62; Ann. R. Bot. Gard. Calc. 14 (1938) 221, pl. 87.—*D. havilandii* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 40, as regards the Banka specimen.

Underground parts unknown. Stem as that of *D. havilandii*. Bulbils none seen. *Leaves* alternate, decidedly coriaceous, ovate or ovate-elliptic, to 15 by 6 cm, acuminate, base rounded, nerves 5 with courses as in *D. havilandii*; petiole to 3 cm long. *Male flowering axes* in large leafless inflorescences, perhaps not quite so strongly negatively geotropic as those of *D. havilandii* for they curve upwards less abruptly than do those of *D. havilandii*. *Female flowering axes* 1-3 together markedly angled. *Capsule* unknown.

Distr. *Malaysia*: Banka. Fig. 9a.

Note. A study of the plant in life is desirable in order to decide if it really differs from *D. laurifolia*.

24. *Dioscorea laurifolia* WALL. [Cat. lith. (1828) no 5111] ex HOOK. f. Fl. Br. Ind. 6 (1892) 293; RIDL. & CURTIS, J. Str. Br. R. As. Soc. 33 (1902) 66; RIDL. Mat. Fl. Mal. Pen. Monoc. 2 (1907) 83; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 39; KNUTH, Pfl. R. 87 (1924) 289; RIDL. Fl. Mal. Pen. 4 (1924) 319; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 222, pl. 88.—*D. oppositifolia* (non L.) CURTIS, J. Str. Br. R. As. Soc. 25 (1894) 149.—Fig. 4c, 10.

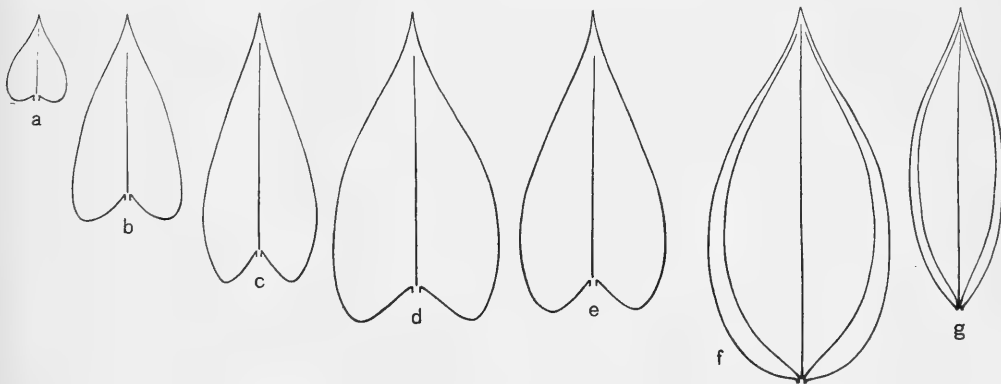


Fig. 10. Leaf-shape in *Dioscorea laurifolia* WALL. ex HOOK. f.: a. the first assimilating leaf of the seedling, b-c. the first and second leaves of the first developed stem, d-e. the first and second leaves of the second developed stem, which stem is not arrested as is the first at the second leaf, f. a leaf from the vegetative part of an adult plant, g. a leaf from a flowering part. All drawn  $\times \frac{1}{3}$ ; the proportions work out approximately as 1 : 4 : 5 : 9 : 7 : 12 : 6.

Tubers 1 or perhaps 2, descending into the soil but not very deeply, flesh red to pink, fibrous in the upper parts. Stem wiry, unarmed, faintly ridged, rooting at times from lower nodes that happen to lie on sufficiently moist soil. *Leaves* alternate, coriaceous, lanceolate-ovate, to 16 by 5 cm on the mature plant, not much less on plants that are not quite mature but of a different shape being auricled at the base (fig. 10), 5-nerved, the outer nerve submarginal, the intermediate nerve as near to the margin as to the midrib; upper surface dull with the larger nerves slightly prominent, lower surface shining, smooth but with the larger nerves raised; petiole rather short, between  $\frac{1}{3}$  and  $\frac{1}{4}$  of the length of the lamina. *Male flowering axes* usually on leafless branches or branch-ends, but occasionally spikes are found in the axils of assimilating leaves, to 7 cm long, angled, with 40–60 flowers spaced their own diameter apart. Buds slightly longer than globose. *Female flowering axes* 1–2 together to 10 cm long or a little more. *Capsules* relatively large, wings to 27 by 24 mm, apex of capsule retuse, base obtuse.

*Distr. Malaysia:* Malay Peninsula, W. side (not yet in Kelantan, Pahang, and Trengganu). Fig. 9a.

*Ecol.* Plentiful in the mountains, particularly the Main Chain, 0–1200 m. *Fl.* irregularly, flowers strongly benzoin-scented.

**25. *Dioscorea prainiana*** R. KNUTH, Pfl. R. 87 (1924) 286, *pro specim. Mal.*; BURK. Dict. (1935) 824; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 225, pl. 89.—*D. deflexa* (non GRIS.) HOOK. f. Fl. Br. Ind. 6 (1892) 293; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 83.—*D. glabra* (non ROXB.) RIDL. *op. cit.* as regards his 8059.—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Jav. 3 (1924) 115, *in syn.*—*D. maliliensis* R. KNUTH in FEDDE, Rep. 36 (1934) 127.

Tuber thrust deep into the soil, subglobose, to 30 by 15 cm, on the end of a stalk perhaps 30 cm long, flesh yellow. Stem climbing to 16 m, unarmed, to 5 mm in diam. at the base. Plant glabrous. Bulbils not seen. *Leaves* alternate on the thinner stems and opposed on the thicker, elliptic or ovate-elliptic, to 15 by 7 cm, acuminate, base rounded, 5–7-nerved, the outermost nerves when there are 7 very weak and submarginal, 5-nerves more usual; secondary nerves only a little more distinct than the network which is only just visible on the upper surface; lower surface with prominent primary nerves; petiole to 6 cm or  $\frac{1}{3}$  to  $\frac{1}{4}$  the length of the blade. *Male flowering axes* gathered into decurved inflorescences which may be 60 cm long; the axes themselves to 8 cm with upwards of 60 flowers set their own diameter apart. Buds ovoid and not exceeding  $1\frac{1}{2}$  mm in length. *Female flowering axes* to 50 cm long, markedly angled. *Capsules* relatively large; wings 25 by 30 mm, apex retuse to almost truncate, base almost truncate.

*Distr. Malaysia:* NE. Sumatra (Berastagi and Sibolangit), Malay Peninsula (Perak, S to Singapore and apparently also in Pahang and Trengganu, but the material brought as yet from these

two States is sterile), Central Celebes (a ♂ plant, KJELLBERG 2009, from Malili). Fig. 9c.

*Ecol.* Ascending in the Malay Peninsula to 350 m, but in Sumatra to 500 m and yet higher.

*Note.* Attention is drawn to the manner in which the primary nerves may diverge at the base of the lamina—a gradual diverging which implies an unusual ratio between the rates here of longitudinal and latitudinal growth.

*D. kingii* should be compared, as the same happens in it. RIDLEY (Fl. Mal. Pen. 5, 1925, 340) holding this species and his *D. tenuifolia* to be one, claims the latter name for it.

**26. *Dioscorea warburgiana*** ULINE *ex* KOORD. Minahassa 19 (1898) 313, *nomen*; PRAIN & BURK. J. As. Soc. Beng. new ser. 4 (1908) 456; *ibid.* 10 (1914) 40; MERR. En. Philip. Fl. Pl. 1 (1922) 219; R. KNUTH, Pfl. R. 87 (1924) 291; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 227, pl. 93.

Underground parts unknown. Plant glabrous. Stem unarmed in the upper parts, probably throughout, smooth. Bulbils none seen. *Leaves* at the horizon of flowering opposite, almost coriaceous, elliptic-ovate, to 17 by 10 cm, shortly acuminate, 7-nerved, the outermost nerves weak and submarginal; upper surface with the nerves distinct, the secondary tending to break up in the network; petiole short, to 5 cm or  $\frac{1}{3}$  to  $\frac{1}{4}$  the length of the lamina. *Male flowering axes*, as far as seen, in fascicles in the leaf-axils, unusually long, to 20 cm, bearing about 80 flowers spaced at rather more than their own diameters apart, conspicuously angled. Buds globose, to  $1\frac{1}{2}$  mm long. *Female flowers* unknown. *Capsules* broad, wings 22 by 22 mm, on a stipe 6–7 mm long.

*Distr. Malaysia:* Celebes (N. peninsula). Fig. 9d.

*Ecol.* *Fl.* irregularly; flowers benzoin-scented.

**27. *Dioscorea vanvuurenii*** PRAIN & BURK. Kew Bull. (1925) 63 & Ann. R. Bot. Gard. Calc. 14 (1938) 224, pl. 91.

Underground parts unknown. Plant glabrous. Stem in the upper parts unarmed, scarcely ridged. Bulbils none seen. *Leaves* at the horizon of flowering opposed, coriaceous, ovate, to 3 by 2 cm, shortly acuminate, 5-nerved; petiole about  $\frac{1}{3}$  the length of the lamina. *Male flowering axes* in small fascicles on leafless branch-ends and also in the axils of leaves on the stem, to 5 cm in length, erect in response to gravity, with about 60 flowers. Buds globose. *Female plant* unknown.

*Distr. Malaysia:* Central and SE. Celebes (Kendari at 300 m, KJELLBERG 671). Fig. 9b.

**28. *Dioscorea vilis*** KUNTH, En. Pl. 5 (1850) 400; ZOLL. Syst. Verz. (1854) 68; MIQ. Fl. Ind. Bat. 3 (1859) 576; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 41; R. KNUTH, Pfl. R. 87 (1924) 290, *quoad specim.* ZOLL.—*D. filiformis* (non BL.) KOORD. Exk. Fl. Java 1 (1911) 309; *ibid.* 4 (1923) fig. 500 (indifferent); PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 228 with part of pl. 90, excluding the reference to BLUME's plant, the upper right hand figure of pl. 90 and pl. 94.—*D. oppositi-*

*folia* (non L.) BACKER, Handb. Fl. Java 3 (1924) 115, in small part.

Tuber apparently burying itself deep, edible, slender, attaining 25 cm and more. Plant glabrous. Stem 3–4 mm in diameter at the base and with a few small prickles there, unarmed above, terete or

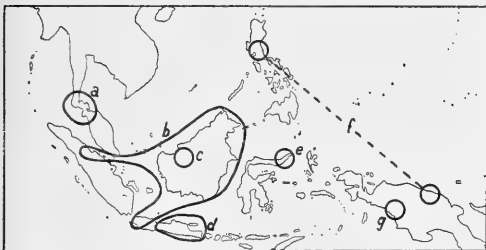


Fig. 11. Distribution of the Malaysian species of *Enantiophyllum* with narrow leaves, a. *D. calicicola* PR. & B., b. *D. salicifolia* BL., c. *D. moultonii* PR. & B., d. *D. vilis* KUNTH, e. *D. sp. indet.* (KOORDERS 16731), f. *D. grata* PR. & B., g. *D. elegans* RIDL. ex PR. & B.

very obscurely ridged, climbing to 16 m (KOORDERS). Bulbils none seen. *Leaves* alternate, herbaceous, broadly lanceolate to narrowly ovate, 10 by 4 cm, acuminate, 7-nerved; upper surface with the larger nerves prominent; petiole to 4 cm or to  $\frac{1}{4}$  or  $\frac{1}{3}$  of the lamina. *Male flowering axes* all in fascicles in leaf-axils, 1–3 together, assuming an upright position in response to gravity, to 7 cm long with about 50 flowers; axis strongly ridged and minutely scabrid. Buds globose except that the base is flattened. *Female flowers* unknown. *Capsules* rather large, apex retuse, base almost retuse about the stipe; wings more or less evenly rounded, 18–20 by 20 mm; stipe 7–8 mm long.

*Distr. Malaysia:* Java (from Mt Gedeh eastward). Fig. 9e, 11d.

*Ecol.* In the mountains, 650–2400 m, apparently rare, also in *Casuarina* forest.

*Notes.* The nomenclature has been confused from not recognizing BLUME's plant of *D. filiformis*; a careful examination of BLUME's authenticities, which are unfortunately only with very young bud, leads to the conclusion that they represent poor specimens of what has later been called *D. myriantha* (see p. 329).

**29. *Dioscorea peperoides* PRAIN & BURK.** in ELMER, Leaf. Philip. Bot. 5 (1913) 1597; J. As. Soc. Beng. new ser. 10 (1914) 28; R. KNUTH, Pfl. R. 87 (1924) 269; PRAIN & BURK. in LECOMTE Fl. Gén. I.C. 6 (1934) 736; Ann. R. Bot. Gard. Calc. 14 (1938) 230, pl. 95.—*D. luzonensis* (non SCHAUER) MERR. & MERRITT, Philip. J. Sci. 5 (1910) Bot. 339.

Underground parts unknown, but assuredly as those of *D. luzonensis*. Plant glabrous. Stems, at least in the upper parts, unarmed, with very faint ridges. Bulbils none seen. *Leaves* on the larger stems opposed, but on the plant more often alternate than opposed, broadly cordate with evenly

rounded auricles or angular auricles [*var. sagittifolia* PRAIN & BURK. (1914)] to 12 by 12 cm, 7–9-nerved, acuminate; petiole about as long as the lamina. *Male flowering axes* 1–4 together in fascicles in leaf-axils, more or less erect, up to 6 cm long with about 60 flowers spaced so as to be in contact one with another; axis angled. Buds rather more elongated than globose, to  $1\frac{1}{2}$  mm long. *Female flowering axes* 1–2 together slightly angled. *Capsule* slightly retuse at the apex, more or less rounded at the base; wings 17 by 10 mm, nearly semicircular; stipe to 3 mm long.

*Distr.* Tonkin (a variety) and *Malaysia:* Philippines. Fig. 9f.

*Ecol.* Chiefly in the mountains of Luzon, ascending to 1300 m, where pine forests commence, growing there in thickets, but also found at sea-level in Golo Island off Mindoro and on limestone cliffs in the Pabellones Islands off Palawan.

*Notes.* *D. peperoides* is very closely allied to *D. luzonensis* but has much smaller flowers and slightly different leaves. It has not been found that the two grow together. There is no indication that it is distinguished in the field from *D. luzonensis* and is probably used as food equally.

**30. *Dioscorea luzonensis* SCHAUER, Nov. Act. Nat. Cur. 19, Suppl. 1 (1843) 444; MIQ. Fl. Ind. Bat. 3 (1859) 571; NAVES, Fl. Filip. Novis. App. (1880) 258; VIDAL, Phan. Cuming. Philip. (1885) 153; Rev. Pl. Vasc. Filip. (1886) 176; CERON, Cat. Pl. Comis. Fl. For. (1892) 171; PRAIN & BURK. in ELMER, Leaf. Philip. Bot. 5 (1913) 1597; J. As. Soc. Beng. new ser. 10 (1914) 28; WESTER, Philip. Agr. Rev. 9 (1916) 175; W. H. BROWN, Bull. 22 Philip. Bur. For. 2 (1921) 258; MERR. En. Philip. Fl. Pl. 1 (1922) 21; R. KNUTH, Pfl. R. 87 (1924) 270; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 232, pl. 96–97.—Fig. 4f.**

Tuber one a year, subclavate, descending down to a depth of 1 m; flesh white or pinkish white, esculent. Plant glabrous. Stem unarmed, faintly ridged. Bulbils none seen. *Leaves* on the larger stems opposed, but more often alternate than opposed, cordate with the auricles somewhat hastately extended, shortly acuminate, 15 by 12 cm, 5–7-nerved; petiole about as long as the lamina. *Male flowering axes* 2–4 together in fascicles in the axils of upper leaves, to 7 cm long with about 60 flowers spaced their own diameter apart. Buds nearly globose, to 2 mm long. *Female flowering axes* solitary, to 22 cm long, carrying up to 35 flowers, angled. *Capsules* truncate at the apex, very obtuse at the base, wings to 22 by 15 mm, ashy green when nearly dry, stipe to 5 mm long.

*Distr. Malaysia:* Philippines (Luzon, Palawan). Fig. 9f.

*Ecol.* Chiefly at low elevations, not collected in the parts of Luzon where the climate has no break in humidity, but plentiful in the provinces near Manila where there are two dry breaks in the year. *Fl.* Sept. or possibly earlier. The size of the male flowers is noteworthy.

*Vern.* In Luzon it shares its names with *D. peperoides*; and in a less measure with other mem-

bers of the genus. In Tagalog it is *kobag* or *ubag*; *pakwit*, *korini* and *mayatbang*. The number and diversity is curious. In Ilocano it is *kamangeg* and in confusion with *D. bulbifera* is *aribukbuk* or *aribubu*.

Uses. The tubers are often used as food, chiefly because it is abundant where it grows and search is quickly rewarded. To dig it out is laborious but to many worth while.

**31. *Dioscorea tenuifolia* RIDL.** J. Str. Br. R. As. Soc. 41 (1904) 34; R. KNUTH, Pfl. R. 87 (1924) 289; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 414, pl. 146.—*D. zollingeriana* (non KUNTH) MIQ. Fl. Ind. Bat. Suppl. (1860) 611; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 82; Fl. Mal. Pen. 4 (1924) 317, in part.—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Jav. 3 (1924) 115, in part.

Tubers several each year, sphaeroidal, at the ends of rather long descending stalks; flesh esculent. Plant glabrous. Stems sparingly armed at the base, ascending to 16 m. Bulbils none seen. *Leaves* mostly opposed, but also alternate, herbaceous, elliptic or elliptic-ovate, rather shortly acuminate, base rounded to obtuse, 15 by 7 cm, rarely larger even to 16 by 11½ cm, 7-nerved; lower surface sometimes bronzed; petiole to 7 cm. *Male flowering axes* 1 or 2 together from upper leaf-axils and also on weak stem-ends from the axils of bracts that displace leaves, directed downwards apparently in a geotropic response, up to 80 mm long with perhaps 40 flowers spaced 2–3 times their own diameter apart, slender, angled. Buds globose except for a flattened base, to 1 mm long. *Female flowering axes* solitary, attaining 50 cm, with about 40 flowers; axis markedly angled. *Capsules* large, apex retuse, base almost truncate; wings 30 × 35 mm; stipe to 6 mm in length.

Distr. *Malaysia*: Sumatra (East Coast & Palembang), Banka, and Malay Peninsula (Singapore Island).

Note. The leaves, when large, suggest those of *D. orbiculata*, but are glabrous.

**32. *Dioscorea sarasinii* ULINE** ex R. KNUTH, Pfl. R. 87 (1924) 291, excl. fig. 56; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 266, pl. 109.

Underground parts unknown. Plant glabrous. Stem in the upper parts unarmed, faintly ridged. Bulbils none seen. *Leaves* alternate, but often two so close as to appear opposed, elliptic or elliptic-ovate, abruptly acuminate, rounded at the base, chartaceous, to 12 × 5½ cm, 7-nerved; upper surface quite smooth; petiole to 2 cm or about ¾ the length of the lamina. *Male flowering axes* in dense fascicles in the axils of leaves, up to 10 cm long with perhaps 60 flowers spaced 2–3 times their diameter apart; axis slender, angled, slightly flexuous. Bracts deltoid-acuminate, 1 mm long. Buds ovoid from a narrow base, to 1¼ mm long. Tepals said to be greenish white. Stamens in two series, obviously by elevation of the torus as described in *D. sexrimata*; the torus raises those before the inner tepals higher than those before the outer tepals. *Female flowering axes* attaining 60 cm in

length with upwards of 100 flowers; axis slightly angled. *Capsules* unknown.

Distr. *Malaysia*: Celebes (N. peninsula).

Note. There is a resemblance to *D. vanvurenii* but an absence of negative geotropism in the male flowering axes.

**33. *Dioscorea sexrimata* BURK.** Kew Bull. (1950) 259.—Fig. 4e.

Underground parts unknown. Plant glabrous. Stem unarmed in its upper parts, 2 mm thick at the horizon of flowering, wiry and in its appearance like the stem of *D. laurifolia*. Bulbils not seen. *Leaves* opposed on the thicker parts and alternate distally, lanceolate or broadly lanceolate, base rounded or very obtuse, apex acuminate, to 13 by 3 cm; margin strengthened, 5-nerved; petiole equaling only ¼ the length of the lamina, or even less. *Male inflorescences* one at a time from the axils of upper leaves, some of them exceeding the leaves in length; others shorter; the flower-bearing axes carried on these, 1 or 2 together, are laxly disposed after the manner of the inflorescence of *D. lamprocaula*; anthesis proceeds up the axes whereas in many species of *Dioscorea* anthesis is nearly simultaneous along its whole length. Half grown buds are globose, later the base widens and forms a saddle half embracing the axis. Filament as long as the anther. The torus lifts the organs of the flower: the inner tepals a little, the stamens before the outer tepals rather more, and those before the inner tepals more still; superficially the stamens appear connate, but the impression is false; the lower part of the mid-line of the petals, and the backs of the filaments have their attachment to the torus continued upwards and there arise from this six narrow slits as a complication in the flower-structure. *Female flowers* unknown. *Capsule* (known only from detached valves) just retuse at the apex, the wings 22 by 18 mm; stipe 6–7 mm.

Distr. *Malaysia*: Celebes (SE. Peninsula).

Ecol. In rain forest and among shrubs, ± 300 m alt., fl. in September. If it be right that water held by the fleshiness of the male flowers of *Enantiophylla* preserves them fresh during anthesis for a longer time than would be possible without it, then this upward growth of the torus is an adaptation of interest and it appears as an advance that has originated in Celebes.

**34. *Dioscorea oryzetorum* PRAIN & BURK.** Kew Bull. (1927) 242; Ann. R. Bot. Gard. Calc. 14 (1938) 363, pl. 133.

Tubers several as globose endings on long stalks differing from those of *D. glabra* in these stalks which are sometimes branched; flesh white. Plant glabrous. Stems unarmed, smooth. *Leaves* opposite, varying much its shape, elliptic-cordate to ovate-lanceolate or even linear-lanceolate with a rounded base [var. *angustifolia* PRAIN & BURK. (1927)], acuminate, 10 by 2–6 cm, 5–7-nerved, upper surface with the network obscure; petioles of the broader leaves about ¾ the length of the lamina, but petioles of the narrower leaves short to very short. *Male flowering axes* usually on leafless



branches, but if not then 1-3 together in leaf-axils, the leafless branches to 12 cm in length; flowering axes very thin, to 4 cm in length with flowers to the number of 50. Buds ellipsoid, directed slightly forward, to 1 mm long. Outer tepals 1 mm long. Inner tepals a little shorter, oblanceolate or subspathulate. Stamens with very short filaments. *Female flowering axes* solitary, to 20 cm long, angled, rather slender. *Capsules* relatively small, subglaucous in a degree similar to that of *D. glabra*; apex very slightly retuse; base nearly truncate; wings to 14 by 11 mm; stipe 4-5 mm long.

*Distr.* Siam from 16° N southwards beyond the Isthmus of Kra to *Malaysia* in the Siamese Circle of Sri Tamarat at Kao Chem Tung Song about 8° N, in deciduous forest and scrub or among bamboos.

*Note.* This species possesses variability in its leaf blades as a specific character, demonstrated in the ratio of the breadth to length. Broad-leaved specimens approach *D. glabra*.

**35. *Dioscorea gracilipes* PRAIN & BURK.** Kew Bull. (1925) 63; *ibid.* (1927) 244; Ann. R. Bot. Gard. Calc. 14 (1938) 365, pl. 133.

Underground parts unknown. Plant glabrous. Stem unarmed above and perhaps throughout, wiry. Bulbils none seen. *Leaves* herbaceous, opposite, broadly lanceolate, tapering to the apex so that they are scarcely acuminate, base rounded, 8 by 2 cm, 5-nerved; petiole to 3 cm or  $\frac{1}{2}$  the length of the blade. *Male flowering axes* solitary or sometimes in small fascicles in the upper leaf-axils, to 6 cm long with perhaps 30 flowers spaced about twice their own diameter apart; axis not quite straight, capillary, with ridges descending from the bracts. Buds with a rather broad base and a minute wart over the axis on the upper side, at maturity 1 mm long. *Female flowering axes* wiry, few-flowered. *Capsules* apparently not more than 5 on an infructescence, slightly retuse at the apex, nearly truncate at the base; wings 14-16 by 11 mm; stipe about 4 mm long.

*Distr.* Peninsular Siam, between the Isthmus of Kra and the border of *British Malaya* in the Circles of Puket, near Panggna, and of Surat at Kachanadit.

*Ecol.* It is a limestone plant and a dwarf.

**36. *Dioscorea elegans* RIDL. ex PRAIN & BURK.** Kew Bull. (1925) 65; Ann. R. Bot. Gard. Calc. 14 (1938) 264, pl. 116.—*D. papuana* (non WARB.) RIDL. Trans. Linn. Soc. Lond. Bot. 9 (1916) 227; R. KNUTH, Pfl. R. 87 (1924) 323.

Underground parts unknown. Plant glabrous. Stem in the upper parts unarmed, terete. Bulbils none seen. *Leaves* (at least in the distal parts of the stem) alternate, lanceolate or lanceolate-ovate, acuminate, rounded or just cordiform at the base, 9 by 2 cm, 5-nerved or obscurely 7-nerved; upper surface shining and smooth; petiole short, not exceeding  $\frac{3}{4}$  the length of the lamina. *Male flowering axes* 2-3 together in the axils of the upper leaves, to 7 cm long with 30-40 flowers spaced about their own diameter apart. Buds ovoid, 1 mm

long. *Female flowering axes* solitary, rather slender, to 30 cm long, conspicuously ridged, with capsules so spaced as scarcely to imbricate. *Capsules* subtruncate above, more or less rounded below; wings 20 by 15 mm; stipe 3 mm long.

*Distr. Malaysia:* SW. New Guinea (Utakwa river), 150 to 930 m. Fig. 11g.

**37. *Dioscorea moultonii* PRAIN & BURK.** Kew Bull. (1925) 62; Ann. R. Bot. Gard. Calc. 14 (1938) 265, pl. 108.

Underground parts unknown. Plant glabrous. Stem unarmed in the upper parts, wiry, terete. Bulbils none seen. *Leaves* alternate, coriaceous, broadly lanceolate, narrowed rather gradually into the acumination, base rounded, 8 by 2 cm, 5-nerved; reticulation rather prominent below; petiole short, only  $\frac{1}{2}$  cm long. *Male flowering axes* 1-3 in small fascicles in the axils of upper leaves or in the axils of bracts towards stem-ends, 5-10 cm long with over 60 flowers spaced more than their diameter apart; axis angled conspicuously. Buds elongated and directed obliquely forward, rather more than 1 mm long. *Female plant* unknown.

*Distr. Malaysia:* Borneo (Sarawak). Fig. 11c.

*Note.* There is in the Herbarium at Bogor a sterile specimen from Billiton collected by VORDERMAN with similar leaves, and in the Leyden Herbarium capsules obtained by the same collector in the same island. They have the shape of capsules of *D. pyrifolia*, and it is likely that *D. moultonii* has such. These specimens do not prove that *D. moultonii* occurs in Billiton, but suggest that it should be looked for.

**38. *Dioscorea lamprocaula* PRAIN & BURK.** Kew Bull. (1932) 245; Ann. R. Bot. Gard. Calc. 14 (1938) 343, pl. 126.

Underground parts unknown. Plant glabrous. Stem very prickly at the base, the prickles 3-4 mm long, very tough to more or less woody, to 7 mm in diameter. Bulbils produced which when large are branched. *Leaves* alternate, coriaceous, from narrowly ovate to nearly orbicular, to 17 by 13 cm, 5-7-nerved; nerves somewhat prominent on the lower surface; petiole to 6 cm or half the length of the lamina. *Male flowering axes* collected together along leafless branches which may themselves branch again; the axes varying much in length, the flowers on them spaced at about twice their diameter apart. Buds not flattened at the base and directed obliquely forward, to rather more than 1 mm in length. *Female plant* unknown.

*Distr. Malaysia:* N. Sumatra, Malay Peninsula (Perak, Pahang, Johore), Java (Preanger).

*Ecol.* The Johore locality was swampy forest on the coast; but the other localities are on hills and mountain slopes.

**39. *Dioscorea calcicola* PRAIN & BURK.** Kew Bull. (1925) 64; Ann. R. Bot. Gard. Calc. 14 (1938) 366, pl. 130; RIDL. Fl. Mal. Pen. 5 (1925) 341.

Underground parts unknown. Plant glabrous. Stem wiry, terete, possibly entirely unarmed. Bulbils not seen. *Leaves* firm, narrow, broadest at



the horizon of the insertion of the petiole which, as they are rounded or only just cordiform at the base, means that they taper almost from the base to pass very gradually into the little defined acumen, 12 by 1½ cm; upper surface smooth and shining; petiole to 2–2½ cm long. *Male flowering axes* 1–2 together on very short leafless branches from the upper leaf-axils, branches attaining no more than the mid-length of the axillant leaf; axis very red when dry, to 4 cm in length, with about 50 flowers spaced their own diameter apart. Buds slightly elongated, 1 mm long. *Female flowering axes* though short, rather stout and rigid, solitary, with up to 10 flowers, ridged. *Capsules* bunched close to the axil, only 1–3 to an infructescence, apex retuse; base almost truncate; wings 12–14 by 9–10 mm; stipe 1–2 mm long.

Distr. Peninsular Siam (Circle of Puket), in *Malaysia*: to the N of the Malay Peninsula (Langkawi Islands, Kedah Peak, G. Baling). Fig. 11a.

Ecol. A limestone plant.

**40. *Dioscorea grata* PRAIN & BURK.** J. As. Soc. Beng. new ser. 10 (1914) 35; MERR. En. Philip. Fl. Pl. 1 (1922) 217; R. KNUTH, Pfl. R. 87 (1924) 293; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 376, pl. 134.

Underground parts unknown. Plant glabrous. Stem possibly armed at the base, thin. Bulbils none seen. *Leaves* alternate, rather firm, linear-lanceolate above a very slightly cordiform base, tapering evenly to the apex, 8 by 0.8 cm, 5-nerved; petiole only 1½ cm long, slender. *Male flowering axes* solitary or a small number along weak leafless branches which scarcely exceed the length of the axillant leaves; axis slightly angled, to 2½ cm in length, with about 20 flowers spaced their own diameter apart. Buds subglobose over a broad base, less than 1 mm long. *Female flowering axis* short, giving rise to few capsules. *Capsules* with the apex truncate, base obtuse, wings 20 by 15 mm; stipe 3 mm long.

Distr. *Malaysia*: Philippines (Luzon: Rizal prov.), NW. New Guinea (Nabire: KANEHIRA & HATUSIMA 12301). Fig. 11f.

Ecol. In New Guinea in *Agathis*-forest at 300 m.

Note. A first impression was that *D. grata* is a depauperate state of *D. loheri*; but this has not been demonstrated; and the detection of the plant in New Guinea goes against it. The New Guinea plant is an exact match of that of the Philippines.

**41. *Dioscorea opaca* R. KNUTH**, Pfl. R. 87 (1924) 283; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 342, pl. 126.—*D. carrii* and possibly also *D. morobensis* R. KNUTH in FEDDE, Rep. 52 (1937) 164.

Underground parts unknown, but the tuber is said to be eaten. Plant glabrous. Stem with minute prickles near its base, ridged, to 4 mm in diam. Bulbils not seen. *Leaves* coriaceous, opposite or subopposite, broadly ovate, rounded at the base, with a long acumen, to 14 by 9 cm, 5-nerved; lower surface with even the smaller nerves some-

what prominent; petioles to 8 cm. *Male flowering axes* on small leafless rather lax branches and on leafless branch-ends, 1–3 together, to 5 cm long, with ca 30 flowers spaced rather more than their own diameters apart, slender, straight, ridged. Buds somewhat elongated, to 2 mm long. *Female plant* unknown.

Distr. *Malaysia*: New Guinea.

Ecol. Mountains, 850–1750 m.

**42. *Dioscorea wallichii* HOOK. f.** Fl. Br. Ind. 6 (1892) 295; R. KNUTH, Pfl. R. 87 (1924) 274; PRAIN & BURK. in Fl. Gén. I.C. 6 (1934) 741; Ann. R. Bot. Gard. Calc. 14 (1938) 281, pl. 115.—*D. aculeata* LINNÉ, Sp. Pl. (1753) 1033 *quoad* ref. RHEEDE, but excluding the bulbils added to his figure.

Tuber descending deeply into the soil, 1 m or more long; flesh white, edible. Plant glabrous. Stem armed at the base, smooth, to 4 mm in diameter. Bulbils not produced. *Leaves* alternate, herbaceous, broadly cordate, shortly acuminate, to 25 by 25 cm, 7-nerved; lower surface somewhat glaucous; petiole about as long as the lamina, its lower pulvinus as a rule tinged with a purplish red. *Male flowering axes* on leafless axillary branches not exceeding 10 cm which have a characteristic pyramidal shape; axes that bear the flowers to 5 cm long carrying 20–30 flowers spaced rather more than their own diameter apart. Buds globose, 1 mm in diameter. *Female flowering axes* 1–2 together, to 50 cm long. *Capsules* usually not more than 5 on an infructescence; apex rounded or truncate; base obtuse or rounded; wings 18 by 15–18 mm; stipe about 4 mm long.

Distr. India (Bombay coast to the Bengal plains, the lower Himalaya and hills of the Assam-Burma frontier), S to beyond the Isthmus of Kra in *Malaysia* in the Circle of Surat at Chumpawn.

**43. *Dioscorea madiunensis* PRAIN & BURK.** Kew Bull. (1925) 63; Ann. R. Bot. Gard. Calc. 14 (1938) 229, pl. 92.—*D. gedensis* PRAIN & BURK. Kew Bull. (1925) 64; Ann. R. Bot. Gard. Calc. 14 (1938) 374, pl. 92.

Underground parts unknown. Plant glabrous. Stem possibly armed at the base, very inconspicuously ridged. Bulbils none seen. *Leaves* opposed or alternate, ovate or lanceolate-ovate with a slightly cordiform base, acuminate, 8–10 by 4 cm, 5-nerved; petiole to 3 cm or more or less ¼ the length of the lamina. *Male plant* unknown. *Female flowering axes* 1–2 from upper leaf-axils, to 15 cm long. *Capsules* large, apex and base retuse; wings to 28 by 25 mm, stipe to 6 mm long.

Distr. *Malaysia*: Java (Mt Gedeh, Ponorogo), hills and mountains.

Note. The capsules of this species are the largest among Malaysian *Enantiophylla*.

**44. *Dioscorea sitamiana* PRAIN & BURK.** Kew Bull. (1925) 64; Ann. R. Bot. Gard. Calc. 14 (1938) 372, pl. 134.

Underground parts unknown. Plant glabrous. Stem unarmed in the upper parts. Bulbils none seen. *Leaves* opposed, herbaceous, oblong-ovate,

shortly and abruptly acuminate, drying a dark brown colour; base rounded or very obtuse, to 6 by  $2\frac{1}{2}$  cm on the parts collected (but larger leaves certainly occur below the horizon of flowering), 5-nerved; petiole short, only about  $1\frac{1}{2}$  cm long. *Male flowering axes* 1-3 together on leafless branches of moderate length or on leafless branchlets, 4-5 cm long, angled, with 20-30 flowers spaced their own diameter apart. Buds globose, except that the base is flat, 1 mm long. *Female plant* unknown.

Distr. *Malaysia*: Borneo (Sarawak, Kinabalu).

**45. *Dioscorea nieuwenhuisii* PRAIN & BURK.** Kew Bull. (1925) 65; Ann. R. Bot. Gard. Calc. 14 (1938) 373, pl. 91.

Underground parts unknown. Plant glabrous. Stem unarmed in the upper parts, very indistinctly ridged. Bulbils none seen. *Leaves* opposed, rather firm, exactly ovate, acute or acuminate, the base neatly rounded, 8 by  $3\frac{1}{2}$  cm, 7-nerved; petiole to 5 cm. *Male flowering axes* aggregated rather densely on leafless branches or branch ends which attain 20 cm in length; axis angled, to 2 cm long; flowers spaced about their own diameter apart. Buds subglobose, 1 mm long. *Female plant* unknown.

Distr. *Malaysia*: East Central Borneo.

**46. *Dioscorea kingii* R. KNUTH, Pfl. R. 87 (1924) 289; RIDL. Fl. Mal. Pen. 5 (1925) 341; PRAIN & BURK. Kew Bull. (1925) 66; Ann. R. Bot. Gard. Calc. 14 (1938) 381, pl. 129.—*D. nurii* & *D. harrissii* R. KNUTH, *op. cit.* 352.—*D. porteri* PRAIN & BURK. ex R. KNUTH, *op. cit.* 353; RIDL. Fl. Mal. Pen. 4 (1924) 318.**

Tubers several in one year, thrust deep into the soil on long stalks; flesh soft and more or less esculent. Plant glabrous, of vigorous growth. Stems very prickly at the base and markedly furrowed, attaining 6 mm in diam., becoming unarmed upwards, climbing to 20 m and perhaps more. Bulbils none seen. *Leaves* opposed, firm, broadly lanceolate to elliptic-ovate, rounded at the base or just cordiform at the horizon of flowering (leaves in youth forms are sagittate), to 15 by  $4\frac{1}{2}$ - $5\frac{1}{2}$  cm, sometimes larger even to 20 by  $4\frac{1}{2}$  cm, 5-7-nerved, the primary nerves with the peculiarity of the first pair not leaving the midrib at the base of the lamina, but curving away a few mm above; lower surface often suffused with a reddish purple colour (*var. purpureovenia* PRAIN & BURK. ex RIDL.); petiole about 4 cm long. *Male flowering axes* 1-4 together, assembled on large leafless branches that are produced high among forest trees and difficult to obtain; axes rather wiry, to 3 cm long and carrying about 30 flowers spaced about their own diameter apart. Buds subglobose,  $1\frac{1}{2}$  mm long, sometimes with a small wart over the axis on the base. *Female flowering axes* solitary. *Capsules* slightly retuse at the apex, nearly truncate at the base; wings 20 by 22 mm; stipe to 6 mm long.

Distr. *Malaysia*: Malay Peninsula.

Ecol. In high forest; it seems to grow for many years without flowering.

**47. *Dioscorea salicifolia* BL.** En. Pl. Jav. 1 (1827) 23; KUNTH, En. Pl. 5 (1850) 390; MIQ. Fl. Ind. Bat. 3 (1859) 573; KOORD. Exk. Fl. Java 1 (1911) 309 *quoad cit.* BLUME & 4 (1923) 270 only the figures on the right; R. KNUTH, Pfl. R. 87 (1924) 290; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 374, pl. 91.—*D. gracillima* (non MIQ.) RIDL. & WINKLER, Bot. Jahrb. 44 (1910) 528.—*D. glabra* var. *salicifolia* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 37; MERR. En. Born. (1921) 118.—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Jav. 3 (1924) 115, in small part.—*D. sarawakensis* R. KNUTH *op. cit.* 291.

Underground parts unknown. Plant glabrous. Stem unarmed in its upper parts, faintly ridged. Bulbils none seen. *Leaves* opposed or alternate, firmly herbaceous, lanceolate or sometimes with the base just cordiform, shortly acuminate, up to 10 by  $2\frac{1}{2}$  cm, 5-nerved; petiole short, usually only 2 cm. *Male flowering axes* aggregated on leafless branches of considerable length, but not uncommonly some in fascicles in the leaf-axils; axes  $1\frac{1}{2}$ -2 cm long, the longer of these are found at the base of the large branches and the shorter near the end so that the inflorescence tapers a little. Buds globose above their flat base, to 1 mm long. *Female plant* not yet known.

Distr. *Malaysia*: Sumatra, W. Java, Borneo. Fig. 11b.

Ecol. Mostly in the hills and montane, but also in the lowland.

Note. The specimens from E. Java (KOORDERS 23608) and from NE. Celebes (KOORDERS 16731), referred to *D. salicifolia*, do not belong to this species.

**48. *Dioscorea filiformis* BLUME.** En. Pl. Java 1 (1827) 22; KUNTH, En. Pl. 5 (1850) 400; MIQ. Fl. Ind. Bat. 3 (1859) 576; MERR. En. Philip. Fl. Pl. 1 (1922) 217.—*D. myriantha* KUNTH, *op. cit.* 382; CERON, Cat. Pl. Comis. Fl. For. (1892) 171; KOORD.-SCHUM. Syst. Verz. 9 (1912) *genus* 1252; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 38 *excl. ref. D. salicifolia* ULIN; KOORD. Exk. Fl. Java 4 (1923) fig. 505, indifferent; R. KNUTH, Pfl. R. 87 (1924) 271; RIDL. Fl. Mal. Pen. 1 (1924) 317; PRAIN & BURK. Kew Bull. (1927) 239; Ann. R. Bot. Gard. Calc. 14 (1938) 293, pl. 120, *excl. syn. D. salicifolia*, *D. koordersii* R. KNUTH & *D. sp.*—*D. gibbiflora* Hook. f. Fl. Br. Ind. 6 (1892) 294; CURTIS, J. Str. Br. R. As. Soc. 25 (1894) 149; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 92; R. KNUTH, *op. cit.* 266; RIDL. Fl. Mal. Pen. 4 (1924) 317; PRAIN & BURK. Gard. Bull. Str. Settl. 5 (1930) 51; Ann. R. Bot. Gard. Calc. 14 (1938) 291, pl. 120.—Fig. 4g.

Tuber descending deeply into the soil, 50 cm and more long, increasing in diameter somewhat downwards until 2 cm through near the apex; flesh white or nearly so, esculent. Plant glabrous. Stem unarmed, often with a purple flush, with very faint ridges. Bulbils produced. *Leaves* opposed on the larger stems, but more often alternate, herbaceous, between cordate and hastate, the basal sinus cut into a bay on either side of the petiole (this character is very well marked in the type of *D.*

*myriantha*, but not so well marked in the type of *D. filiformis*; the laminae in the first measure to 10 by 7 cm and those in the second to 10 by 5½ cm), acuminate, 5–7-nerved, the first pair of primary nerves nearer to the margin than to the midrib; upper surface dull; lower often tinted with purple;



Fig. 12. Distribution of *D. filiformis* Bl.

petiole rather shorter than the lamina. *Male flowering axes* either on special leafless branches with relatively long internodes between one group of axes and the next, or less commonly in fascicles in leaf-axils, 10–15 mm long, zigzag with a flower on each angle, narrowly ridged beneath each bract. Buds globose over a flat base and with a minute wart on the upper side against the axis, 1 mm long. *Female flowering axes* solitary, to 20 cm long, rather slender and a little flexed at the flowers, but not zigzag as are the male flowers. *Capsules* rather large; apex retuse; base almost truncate; wings to 24 by 22 mm, somewhat shining when dry; stipe 3 mm long.

*Dist.* Siam and throughout the N. and S. parts of *Malaysia*, but not yet known from the most equatorial, and not yet found in New Guinea. Fig. 12.

*Ecol.* A lowland plant apparently indifferent to chalk, but demanding drainage.

*Vern.* *Aroi huwi churuk* (or snout yam climber), *S. dudung*, *J. kiroi* or *kiru* (Tagalog) are recorded, but convey little information as they are not exclusive.

**49. *Dioscorea alata* LINNÉ, Sp. Pl. (1753) 1033; N. L. BURMAN, Fl. Ind. (1768) 214; THUNB. Fl. Jav. (1825) 6; BLUME, En. Pl. Jav. 1 (1827) 22; BLANCO, Fl. Filip. (1837) 799; MIQ. Fl. Ind. Bat. 3 (1859) 572; Suppl. (1860) 60, 270; WATT, Dict. 3 (1890) 126; WARBURG, Bot. Jahrb. 13 (1891) 274; Hook. f. Fl. Br. Ind. 6 (1892) 296; RIDL. & CURTIS, J. Str. Br. R. As. Soc. 30 (1897) 279; KOORD. Minahassa (1898) 312; MERR. Rev. Sp. BLANCO Fl. Filip. (1905) 86; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 84; KOORD. Exk. Fl. Jav. 1 (1911) 308; PRIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 39; BURK. Gard. Bull. Str. Settl. 1 (1917) 371, 3 pl.; MERR. Interpr. Rumph. Herb. Amb. (1917) 146; En.**

Philip. Fl. Pl. 1 (1922) 215; HEYNE, Nutt. Pl. Ned. Ind. (1927) 456; BURK. Gard. Bull. Str. Settl. 3 (1923) 4, 2 pl.; R. KNUTH, Pfl. R. 87 (1924) 265; BACKER, Handb. Fl. Jav. 3 (1924) 114; OCHSE, Veget. Dutch E. I. (1931) 229; BURK. Dict. (1935) 814; PRIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 302, pl. 123–125.—*D. eburna* LOUR. Fl. Coch. (1790) 625.—*D. eburnea* WILLD. in LOUR. Fl. Coch. ed. 2, 3 (1793) 767.—*D. atropurpurea* ROXB. Hort. Beng. (1814) 72, nomen.—*D. globosa*, *D. purpurea*, *D. rubella* ROXB. Fl. Ind. 3 (1832) 797–800.—*D. vulgaris* MIQ. op. cit. 572.—*D. sativa* (non L.) MUNRO, Hort. Agr. (1844) 30.—*D. javanica* QUEVA, Mém. Soc. Sc. Lille IV, 20 (1894) 372, pl. 18/5.

Tuber polymorphous, (i) cylindrical or clavate and deeply descending into the soil even to 1½ m, (ii) globose and stout and short (*D. globosa* ROXB.), (iii) pyriform, (iv) lobed in various way, (v) fingered, (vi) fingered and fasciated (*D. vulgaris* MIQ.), (vii) losing its positive geotropism with a subsequent change of direction in the soil (*D. spiculata* BL. only as to ref. to RUMPH); skin brown to black; flesh white or ivory coloured or purple, either superficially or throughout (for the complete range of shapes see Ann. R. Bot. Gard. 14, pl. 125), never poisonous. Plant glabrous. Stem unarmed though rather rarely rough or warted close to the soil, climbing to 10 m, quadrangular and as a rule conspicuously 4-winged above the very base at which the leaves are not decussate. Bulbils abundant, more so in some races than in others. *Leaves* generally a few alternate at the very base, thereafter opposed, herbaceous, subsagittately or subhastately ovate, rarely subhastately deltoid, shortly acuminate, usually to 22 by 15 cm, the upper surface bright green, 5-nerved; petiole about as long as the lamina, sometimes marginally frilled, sometimes with the pulvini suffused with purple. *Male flowering axes* 1–2 together, aggregated on leafless branches which only rarely exceed 30 cm in length, with upwards of 20 flowers spaced about their own diameter apart. Buds somewhat flattened at the base, otherwise nearly globose 1 mm long, at times the axis a little zigzag with the buds on the angles. *Female flowering axes* 1 from an axil, decurved but rigid, to 60 cm long with about 20 flowers, angled or at the base narrowly winged. *Capsules* at the apex slightly retuse, at the base obtuse; wings 17–20 by 15 mm; stipe 3–4 mm long.

*Dist.* Cultivated throughout *Malaysia* and indeed throughout the moister tropics. It originated in continental Asia, but seems to have been ennobled not a little in *Malaysia* (see BURKILL, Adv. Sc. 7, 1950, 443). It thrives on a rainfall of 1500 mm annually with a resting period of about 2 months. It gives its harvest at the same time as the rice; and in parts of the East where the amount of rice raised is not quite adequate, *D. alata* is one of the first of supplementary resources, but since the introduction of American sources of starchy food *D. alata* has lost considerably in importance. Because it keeps well and the crop is ready when the period of calms begins sailors carried it on voyages and man early took it both out into the

Pacific and to such parts on the western side of the Indian Ocean as are not too dry for its thrift. Europeans after A.D. 1500 carried it round the Cape to both sides of the Atlantic. It is invariably grown from clones, and varietal names are therefore inappropriate.

Vern. The tuber is called *ubi*, *ovi*, *owe*, *ohi*, *hubi*, *huwi*, *ohi*, through western Malaysia, eastwards *iwi*, *wiwi*, *wili*, almost to the exclusion of other nouns. But in Celebes *lame* meaning that which is planted, holds a place. It is *lulu* in Banda; *heri* or *heli* in Ambon; *gusuo* in Halmahera, *kinampai* among the Bisayan languages of the Philippines. Right through Polynesia the name used is derived from *ubi*.

**50. Dioscorea nummularia** LAMK, Encycl. Méth. 3 (1789) 231; WILLD. Sp. Pl. 4 (1806) 792; BLUME, En. Pl. Jav. 1 (1827) 21, *quoad specim.*; MIQ. Fl. Ind. Bat. 3 (1859) 572 in small part; PRAIN & BURK. in ELMER, Leaf. Philip. Bot. 5 (1913) 1599; J. As. Soc. Beng. new ser. 10 (1914) 35; MERR. Interpr. Rumph. Herb. Amb. (1917) 148; En. Philip. Fl. Pl. 1 (1922) 217; HEYNE, Nutt. Pl. Ned. Ind. 1 (1922) 500; R. KNUTH, Pfl. R. 87 (1924) 282; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 367, pl. 132.—*D. villosa* L. (non 1753) in STICKMAN, Herb. Amb. (1754) 142.—*D. glabra* (non ROXB.) KOORDERS, Minahassa (1898) 312.—*D. seemannii* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 34; R. KNUTH, *op. cit.* 272.—*D. koordersii* PRAIN & BURK. ex KOORD-SCHUM. Syst. Verz. 3 (1914) 20, non R. KNUTH, *op. cit.* 291.—*D. angulata*, *D. glaucoidea*, *D. lufensis*, *D. palauensis* & *D. raymundii* R. KNUTH, *op. cit.* 191, 272, 283, 284.—*D. paloneusii* R. KNUTH in FEDDE, Reper. 36 (1937) 69.

Tubers descending deep into the soil, increasing in diameter downwards slowly by a long undefined stalk, to 1 m long and 6 cm in diam.; flesh white, esculent. Plant glabrous. Stem armed, sometimes abundantly at the base, rather wiry, with very obscure ridges. Bulbils none seen. *Leaves* opposed on the larger stems and alternate elsewhere, but more abundantly opposed than alternate, firmly herbaceous, from exactly cordate to broadly elliptic, with a rounded base, apex rather abruptly acuminate, to 11 by 9 cm, 5-7-nerved; petiole to 7 cm. *Male flowering axes* 1-4 together, aggregated on downwardly directed leafless branches to 4 cm long, with about 50 flowers spaced their own diameter apart, angled. Buds almost globose above a flattened base, to 1¼ mm long. *Female flowering axes* 1-2 together, to 15 cm long; axis angled. *Capsules* with the apex retuse, the base obtuse; wings 20 by 22 mm; stipe to 5 mm.

Distr. Pacific as far as Tahiti (whither perhaps man took it) to East Malaysia (westward the N. corner of Borneo and Celebes in great abundance, not yet recorded from the Lesser Sunda Islands).

Ecol. & Vern. The esculent tuber of this most common species of *Dioscorea* in E. Malaysia lies too deep, yields too little and that unpleasant in carrying saponin to give the plant any prominence as a source of food. The tough stems serve for a handy bit of cordage when needed in the forest,

whence the word *tali* or cord in its name (see under *Enantiophyllum* above). Some additional recorded names are *uwi* in *tuwa* in N. Celebes, *ubing basol* in Tagalog (Luzon) which recalls RUMPHIUS's *ubi bisol*, *banan* in Bagobe (Mindanao), *tatopo* in Halmahera, *singgo* in the Kem language of western New Guinea and *boku* of Port Moresby (New Guinea). It shares *pakit* in Tagalog with its allies.

Notes. A slight difference of the NE. Celebes specimens from the type (from Ambon) led to the distinction of *D. koordersii* PRAIN & BURK. ex KOORD-SCHUM. which name does not cover *D. koordersii sensu* R. KNUTH, the latter being a state of *D. filiformis* BL.

RUMPHIUS's figure of the fruiting plant is good; the second figure, that of the plant in bud, is only useful in regard to the stem, as there is in the foliage that which suggests RUMPHIUS's figure of *Stemona* (fig. 129). It is as if the artist had not gone direct to life, but to a wrong model to obtain his way of representing the leaves.

**51. Dioscorea glabra** ROXB. Fl. Ind. 3 (1832) 803; HOOK. f. Fl. Br. Ind. 6 (1892) 294; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 83; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 37 excl. *var. salicifolia*; R. KNUTH, Pfl. R. 87 (1924) 277 excl. the same and ARSIN's specimens; RIDL. Fl. Mal. Pen. 4 (1924) 318 in part; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 354, pl. 131.—*D. nummularia* (non LAMK) ROXB. *op. cit.*—*D. laurifolia* (non WALL.) CURTIS, J. Str. Br. R. As. Soc. 25 (1894) 149.—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Java (1924) 115, in part.—*D. siamensis* R. KNUTH, *op. cit.* 281.

Tuber single or sometimes more than 1, descending deep into the soil on a long stalk gradually increasing in diameter, cylindric, to 50 cm long, 4 cm diam.; flesh white, esculent. Plant glabrous. Stem abundantly armed at the base, climbing to 8 m, tough, very faintly ridged. Bulbils not produced. *Leaves* herbaceous, opposed or alternate, long-cordate, the base varying between cordiform, hastate and rounded, to 14 by 16 cm, but usually not larger than 10 by 10 cm, 5-7-nerved; petiole usually 4-5 cm. *Male flowering axes* 1-4 together aggregated on leafless branches which attain at times 70 cm in length, only very rarely fascicled in leaf-axils; axis to 4 cm in length with about 25 flowers set at less than their diameter apart. Buds globose over their broad base, 1 mm long. *Female flowering axes* solitary or 2 together, to 40 cm long with upwards of 50 flowers; axis angled. *Capsules* slightly retuse at the apex, very obtuse at the base; wings 15-18 by 14-20 mm; stipe to 4 mm long.

Distr. India (particularly in Bengal) and Burma to the centre of the Malay Peninsula. In general a common species wherever it occurs.

Ecol. The tubers are eaten if it is worth while to dig for them. Rarely is the plant encouraged by those who use it for food. It has little importance in the Malay Peninsula though used by the pagan races. It is of considerable importance to the Andamanese.

To distinguish it from *D. nummularia* is often

difficult in herbaria. Dried leaves of the latter are redder and those of *D. glabra* browner; and the blade in *D. glabra* is as a rule somewhat longer than that of *D. nummularia*.

**52. *Dioscorea divaricata*** BLANCO, Fl. Filip. (1837) 797; KUNTH, En. Pl. 5 (1850) 391; WESTER, Philip. Agr. Rev. 9 (1916) 178; MERR. Sp. Blanco (1918) 101; W. H. BROWN, Bull. 22 Bur. For. Philip. 2 (1921) 257; MERR. En. Philip. Fl. Pl. 1 (1922) 216; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 378, pl. 135.—*D. soror* PRAIN & BURK. in ELMER, Leaf. Philip. Bot. 5 (1913) 1598; J. As. Soc. Beng. new ser. 10 (1914) 34; MERR. En. Philip. Fl. Pl. 1 (1922) 219; R. KNUTH, Pfl. R. 87 (1924) 274.—*D. foxworthyi* PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 84; Ann. R. Bot. Gard. Calc. 14 (1938) 380, pl. 136.—*D. oxyphylla* R. KNUTH, op. cit. 269.—Fig. 5q.

Tuber 1 or more, thrust deep into the soil on a long stalk, stalk and tuber together to 1 m in length; flesh edible. Plant glabrous. Stem armed at the base, rather wiry, slightly ridged. Bulbils none seen. *Leaves* opposed, herbaceous, cordately sagittate or subsagittate or ovate-hastate, the auricles not evenly rounded but drawn out as barbs, acuminate, to 16 by 8 cm, 7-nerved; petiole to 7 cm. *Male flowering axes* 1–2 together, aggregated on leafless branches or branch-ends which attain 60 cm in length, carrying upwards of 30 flowers spaced their own diameter apart, slender, angled. Buds globose, above a broad base, 1 mm long. *Female flowering axes* solitary, to 18 cm in length, angled. *Capsules* with the apex slightly retuse, the base obtuse; wings to 21 by 22 mm; stipe to 4 mm.

Distr. *Malaysia*: Philippines (Luzon, Panay, and Cebu).

Note. *D. divaricata* may be described as *D. nummularia* with the outer margins of the laminae straightened. As the leaves of the *Dioscoreas* are variable the propriety of maintaining it as a species has been questioned, but botanists who have been familiar with it in life have maintained it. The vernacular names reflect the difficulty of isolating it. Tagalog names recorded for it are: *kiroi*, *kiroe*, *kireot*, *buloi*, *paket*, *pakwit*, *kobag* and *ubag*; Ilocano, Pangasinan and Sambali: *dulian*, *durian*, *duyan*, *duwiyan*; Biscayan: *baliacag*. They are shared by the species whose tubers are used alternatively.

**53. *Dioscorea loheri*** PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 33; MERR. Sp. Blanco (1918) 101; En. Philip. Fl. Pl. 1 (1922) 217; R. KNUTH, Pfl. R. 87 (1924) 270; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 377, pl. 135.—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Java 3 (1924) 115 in syn.

Tuber less elongated than that of *D. divaricata* but in general similar. Plant glabrous. Stem armed at the base, firm, very indistinctly ridged. Bulbils none seen. *Leaves* opposed as a rule, mostly ovate with the base if not rounded somewhat truncate, but the larger leaves are hastate, acuminate, as a rule about 9 by 2 cm, but at times to 20 by 9 cm, 7-nerved; petiole to 4 cm. *Male flowering axes* 1–3

together, aggregated on rather long leafless branches which attain 20 cm in length, or at times in axillary fascicles; axis angled, to 6 cm long with about 40 flowers spaced their own diameter apart. Buds globose above a broad base, 1 mm long. *Female flowering axes* to 14 cm long or longer, angled. *Capsules* apparently exactly as those of *D. divaricata*.

Distr. *Malaysia*: Philippines (Luzon, in the provinces near Manila).

**54. *Dioscorea merrillii*** PRAIN & BURK. in ELMER, Leaf. Philip. Bot. 5 (1913) 1598; J. As. Soc. Beng. new ser. 10 (1914) 35; MERR. En. Philip. Fl. Pl. 1 (1922) 218; R. KNUTH, Pfl. R. 87 (1924) 271; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 381, pl. 136.

Underground parts unknown. Stem presumably armed at the base, wiry, faintly ridged. Bulbils none seen. *Leaves* opposed, rather coriaceous, long-ovate, sometimes just cordiform at the base, otherwise rounded, shortly acuminate, to 12 by 5 cm; petiole to 5 cm. *Male flowering axes* 1–2 together, aggregated on leafless branches which as far as known are more lax and shorter than those of *D. nummularia* and *D. divaricata*; parts of the branch carry hairs thinly scattered which do not extend onto the axes that carry the flowers; hairs of the stiletto type; axes of the spikes to 4 cm long with flowers spaced about their own diameter apart. Buds nearly globose above their broad base, 1 mm long. *Female plant* unknown.

Distr. *Malaysia*: Philippines (Mindoro, Mindanao), in the hills. Fig. 13d.

Note. As fig. 13 suggests, *D. merrillii* occurs as if marking the front of an advance of hairiness from western Malaysia towards the East.

**55. *Dioscorea pyrifolia*** KUNTH, En. Pl. 5 (1850) 384; MIQ. Fl. Ind. Bat. 3 (1859) 571; Hook. f. Fl.

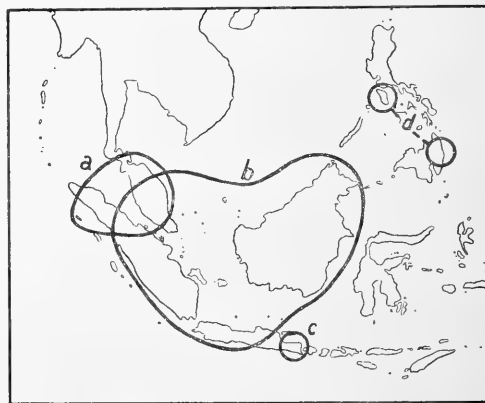


Fig. 13. Distribution of the pubescent species of § *Enantiophyllum* in Malaysia apart from *D. pubera* (fig. 14): a. *D. orbiculata* Hook. f., b. *D. pyrifolia* KUNTH and *D. polyclades* Hook. f. taken together, c. *D. platycarpa* PR. & B., d. *D. merrillii* PR. & B.

Br. Ind. 6 (1892) 292; RIDL. & CURTIS, J. Str. Br. R. As. Soc. 33 (1902) 66; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 82; KOORD. Exk. Fl. Java 1 (1911) 310 (as *pirifolia*); KOORD.-SCHUM. Syst. Verz. Lief. 9 (1912) genus 1252; RIDL. ex GIBBS, J. Linn. Soc. Lond. Bot. 42 (1914) 165; KOORD. *op. cit.* 4 (1923) 266; R. KNUTH, Pfl. R. 87 (1924) 278; RIDL. Fl. Mal. Pen. 4 (1924) 316; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 384, pl. 137, 138.—*D. nummularia* (non LAMK) BLUME, En. Pl. Jav. 1 (1827) 21; O. KUNTZE, Rev. Gen. Pl. 1 (1891) 704—*S. vars glabrescens* and *puberula*.—*D. zollingeriana* KUNTH, En. Pl. 5 (1850) 384; Miq. *op. cit.* 571, not in Suppl.—*D. diepenhorstii* Miq. Fl. Ind. Bat. Suppl. (1860) 611; KOORD. Exk. Fl. Java 4 (1923) 271.—*D. cornifolia* (non KUNTH) RIDL. Mat. Fl. Mal. Pen. 2 (1907) 81.—*D. preangeriana* ULINE ex PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 33 in *syn.*—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Jav. 3 (1924) 115, in chief part; Onkr. Suiker. (1931) 191 with fig. 203.—*D. sandakanensis* R. KNUTH in FEDDE, Rep. 36 (1934) 127.—Fig. 4d, 6d.

Tubers more than 1 each year, thrust deep into the soil even to 2½ m, by long stalks from which they are not sharply differentiated; flesh white; the corm whence the tubers arise is intensely woody. Stems abundantly armed at the base, climbing to 10 m, glabrescent, ca 5 mm in diam. Bulbils absent. Leaves opposed except a few at the very base of the stem, rather firm, ovate-elliptic from a cordiform base, acuminate, the acumen with large glands in it, to 11 by 8 cm; youth leaves hastate; lower surface drying often an intense rust-red, pubescent in various degrees, sometimes only at the petiolar end of the blade; petiole to 4½ cm long. *Male flowering axes* 1–4 together, aggregated on leafless branches or branch-ends; axes to 5 cm long, with perhaps 50 flowers spaced their own diameter apart or a little less, pubescent or puberulous, often curved and upwards showing a slight inconstant negative geotropism. Buds globose above their flat base, 1 mm long. *Female flowering axes* (1)–2–(3) together, to 24 cm long, pubescent, angled. *Capsules* glabrous at maturity, apex slightly retuse; base subtruncate; wings 18–20 by 22 mm; stipe to 7 mm.

Distr. *Malaysia*: Sumatra, Mal. Peninsula, Borneo, and W. Java (E. to Cheribon). Fig. 13b.

Ecol. Ascending to 700 m and possibly higher, confined to an ever-wet climate and often close to running water, so favoured by a wet soil as on roadside borders in Malacca to increase where the road dips into a hollow. It cannot thrive in the tall forest; it will hold a place in the sun provided that the soil is shaded.

The large glands on the leaf-tips have been described by ORR (Not. R. Bot. Gard. Edinb. 73, 1926, 139).

Fl. Mal. Pen., Borneo: Dec.–Jan.; N. Sumatra: Jan.–Dec., April–June; Java: May–June.

Econ. The tubers escape human use and the vernacular names are such as *akar kemenyan* or benzoin climber which recall the scent of the flowers.

## KEY TO THE VARIETIES

1. Stems, when the plant is mature, abundantly prickly in their lowest 10 cm.
2. Lower surface of the leaf with a grey tint.
3. Blade carries hairs on the back near the petiole, but the upper part is without them.
- var. *diepenhorstii*
3. Lamina carries hairs generally, on the lower surface . . . . . var. *pyrifolia*
2. Lower surface of the leaf coated with tawny hairs . . . . . var. *borneensis*
2. Lower surface of the leaf dries a bright rust red. var. *ferruginea*
1. Stem without prickles, even at maturity. var. *subinermis*

*Var. subinermis* PRAIN & BURK. (1938) occurs in the central parts of the Malay Peninsula.

*Var. borneensis* PRAIN & BURK. *l.c.* seems to be common in NE. Borneo.

*Var. diepenhorstii* (MIQ.) PRAIN & BURKILL (1914) is frequent in Java and S. Sumatra.

*Var. pyrifolia* and *var. ferruginea* PRAIN & BURK. (1914) are met with throughout the area that the species occupies. O. KUNTZE published (*op. cit.*) two other varietal names: on a visit to Palabuhan Ratu, on the south coast of western Java he met with *D. pyrifolia* in *var. pyrifolia* and *var. diepenhorstii*, and when he came to name them he called them *D. nummularia var. puberula* and *var. glabrescens*.

**56. *Dioscorea platycarpa* PRAIN & BURK.** Kew Bull. 1925, 65; Ann. R. Bot. Gard. Calc. 14 (1938) 410, pl. 92.

Lower parts unknown. Stem climbing to 16 m, distally unarmed, but probably armed at the base. Bulbils none seen. Leaves opposed, exactly ovate, shortly mucronate, to 8 by 5 cm at the horizon of flowering, 5-nerved; upper surface apparently pubescent when young, but not so when fully grown; lower surface with rather short tawny or reddish hairs in abundance; the secondary nerves broken considerably in the network; petiole to 2 cm. *Male plant* unknown. *Female flowering axes* as far as known, rather short and slender; their flowers not seen. *Capsules* with the apex just retuse, the base truncate; wings 21 by 22 mm, conspicuously broad; stipe to 4 mm.

Distr. *Malaysia*: Java (Besuki), once found. Fig. 13c.

**57. *Dioscorea puber* BLUME, En. Pl. Jav. 1 (1827) 21; KUNTH, En. Pl. 5 (1850) 390; KOORD. Exk. Fl. Java 1 (1911) 310; R. KNUTH, Pfl. R. 87 (1924) 282, in part; PRAIN & BURK. Ann. R. Bot. Gard. Calc. 14 (1938) 402, pl. 138 & 143.—*D. anguina* ROXB. Fl. Ind. 3 (1832) 803 *excl. ref.* RUMPH.; KOORD. Exk. Fl. Java 1 (1911) 310; KOORD.-SCHUM. Syst. Verz. Lief. 9 (1912) genus 1252; PRAIN & BURK. J. As. Soc. Beng. new ser. 10 (1914) 32; KOORD. Exk. Fl. Java 4 (1923) 265.—*D. cornifolia* KUNTH, En. Pl. 5 (1850) 385; Miq. Fl. Ind. Bat. 3 (1859) 571.—*D. oppositifolia* (non L.) BACKER, Handb. Fl. Java 3 (1924) 115, in small part.—Fig. 5r.**

Tubers 1 or 2 each year, driven deep, even to 2 m, into the soil by long stalks, tubers to 8 cm in diam.; skin tawny orange; flesh lemon yellow, fibrous in the upper part of the stalk but edible. Stem warted but not armed at the base, pubescent, to 8 mm in diam. Bulbils large. *Leaves* more often



Fig. 14. Distribution of *D. puber* BL. showing the considerable area in India which seems to be its natural home and outlying posts in Travancore, S. Sumatra, and Java. In SE. Asia *g* on the map indicates where the pubescent *D. oppositifolia* L. grows and *d* where the equally pubescent *D. decipiens* Hook. f. grows.

alternate than opposed, from exactly cordate to ovate-cordate, acuminate, typical leaves to 12 by 9–11 cm, but sometimes as large as 24 by 20 cm; lower surface permanently pubescent, upper surface glabrescent; petiole as long as the blade, usually livid in colour at the pulvini. *Male flowering axes* 1–2 together (usually 2), aggregated on leafless branches which attain 18 cm in length and are densely pubescent; axes to 2 cm long with flowers to the very base, these in number to 30 or more, so little spaced that they touch one another. Buds globose above a flat base, to 1 mm long. *Female flowering axes* 1–3 together in axils of leaves or sometimes on very short axillary branches; axis densely pubescent, up to 15 cm long, with up to 40 flowers. *Capsules* retaining to ripeness in sheltered angles some of their pubescence; apex retuse; base almost truncate; wings 15 by 18 mm; stipe 3–4 mm.

*Distr.* SE. Asia and *Malaysia*: Sumatra (West Coast, once collected), Java (E to Madiun), not in the Moluccas. Fig. 14.

*Ecol.* It has the largest leaves of any of the *Enantiophylla*, the leaf surface attaining almost 200 cm<sup>2</sup>. *Fl.* Java: April–June, India: Aug.–Dec. Ripe fruit has not yet been obtained in Java.

*Econ.* The needy eat the tubers in India, but they make a poor food and it is difficult to think that man can have transported it intentionally.

**58. *Dioscorea orbiculata* Hook. f.** *Fl. Br. Ind.* 6 (1892) 292; CURTIS, J. Str. Br. R. As. Soc. 25 (1894) 149; RIDL. *Mat. Fl. Mal. Pen.* 2 (1907) 82; PRAIN & BURK. *J. As. Soc. Beng. new ser.* 10 (1914) 31;

R. KNUTH, *Pfl. R.* 87 (1924) 281; RIDL. *Fl. Mal. Pen.* 4 (1924) 317; BURK. *Dict.* (1935) 822; PRAIN & BURK. *Ann. R. Bot. Gard. Calc.* 14 (1938) 411, *excl. specim. Born.*, pl. 145.—*D. glabra* (non ROXB.) RIDL. & CURTIS, *J. Str. Br. R. As. Soc.* 38 (1902) 66, in part.—*D. oppositifolia* (non L.) BACKER, *Handb. Fl. Jav.* 3 (1924) 115, in part.—Fig. 5p, 6f.

Tubers several each year on long spreading stalks that may reach 2 m in length; flesh white, edible, delicate. Stem rather sparingly armed at the base, climbing to 10 m, slightly ridged, with rusty red pubescence when young. Bulbils none seen. *Leaves* usually opposed, rather firm, orbicular below the acumen or orbicular-ovate or orbicular-cordate, with a well developed acumen (to 2 cm long), pubescent when young but glabrescent to 18 by 14 cm, 7-nerved; the larger hairs dendroid (fig. 6); petiole to 10 cm, pubescent. *Male flowering axes* 1–6 together, usually aggregated on leafless branches which may be 70 cm long; rarely a few of the axes in fascicles in leaf-axils; axis to 6 cm long with upwards of 50 flowers spaced along it at more than their own diameter apart, coated with brown dendroid hairs. Buds globose above a broad base, 1 mm long. *Female flowering axes* solitary, up to 15 cm long and with upwards of 30 flowers; axis with a coating of brown hairs. *Capsules* large, becoming glabrous before reaching full size; apex truncate; base rounded-truncate; wings to 30 by 26 mm; stipe 8–9 mm.

*Distr. Malaysia*: Sumatra (Asahan), Malay Peninsula (from Phuket to Johore). Fig. 13a.

*Ecol.* By no means uncommon in Perak, *fl.* Oct.–Nov., but also in the less rainy months May–June.

*Econ. & Vern.* The Pagan tribes of the Malay Peninsula eat the tubers; the northern Sakai call them *takob* and *wauh*; but the second vernacular covers more species than *D. orbiculata*; it may have been derived from the Mon-Khmer noun *khoai*. *Takob* is a name well enough known for Malays to use it as *akar takob* (takob climber). Further names collected from pagan tribes are *kud*, *kedak* and *kakap*.

**59. *Dioscorea polyclades* Hook. f.** *Fl. Br. Ind.* 6 (1892) 294; RIDL. *Mat. Fl. Mal. Pen.* 2 (1907) 81; PRAIN & BURK. *J. As. Soc. Beng. new ser.* 10 (1914) 32; KOORD. *Exk. Fl. Java* 4 (1923) 269 as *polycloides*; R. KNUTH, *Pfl. R.* 87 (1924) 275; RIDL. *Fl. Mal. Pen.* 4 (1924) 315; PRAIN & BURK. *Ann. R. Bot. Gard. Calc.* 14 (1938) 407, pl. 144.—*D. nummularia* (non LAMK) MOR. *Syst. Verz.* (1846) 92; KUNTH, *En. Pl.* 5 (1850) 386 *excl. ref.*; ZOLL. *Syst. Verz.* (1854) 68; MIQ. *Fl. Ind. Bat.* 3 (1859) 572 in large part; O. KUNTZE, *Rev. Gen. Pl.* 1 (1891) 704, *pro ref. var. vultina*.—*D. puber* (a) (non BLUME) KOORD.-SCHUM. *Syst. Verz. Lief.* 9 (1912) *genus* 1252; R. KNUTH, *op. cit.* 282, in part.—*D. oppositifolia* (non L.) BACKER, *Handb. Fl. Jav.* 3 (1924) 115, in part.

Tubers very like those of *D. pyriformis*, flesh edible. Stems abundantly armed with rather small prickles in the lower parts but unarmed above, climbing to 30 m, densely pubescent, faintly ridged



under the pubescence. Bulbils none seen. *Leaves* opposed, herbaceous, elliptic-cordate or exactly cordate, or more rarely oblong (*var. velutina* O. K.), acuminate, usually to 12 by 12, but occasionally attaining 25 by 22 cm, 7-nerved, retaining a thin pubescence on the upper surface and more pubescence on the lower; petiole at times prickly, up to 4(-6) cm. *Male flowering axes* 1-4 together, aggregated on leafless branches which rise in the axils of upper leaves and attain 30 cm in length; axes conspicuously longer if at the base of one of these large inflorescences than towards the end, with a characteristic short sterile part at the base below the flowers as a stalk 2-5 mm long, their total length to 2-2½ cm. Flowers about 20 or more, usually touching each other though not in *var. oblongifolia*; pubescent axis angled under the pubescence. Buds more or less globose above a flattened base, 1 mm long. *Female flowering axes* to 20 cm long, covered with tawny hairs; bracts dense-

ly pubescent ovate, acute, 2 mm long. *Capsules* becoming glabrous as they grow to full size; apex retuse; base truncate; wings to 25 by 20 mm; stipe to 5 mm.

*Distr. Malaysia:* Sumatra (incl. Sebesi Island in Sunda Straits), Malay Peninsula, and Java. Fig. 13b.

*Ecol.* Ascending to 700 m.

*Note.* *Var. oblongifolia* ULINE *ex* KNUTH is typified by ZOLLINGER 283 from Java. O. KUNTZE's collections *nos* 5297 and 5279 typifying *D. nummularia* *var. velutina* O. K. sufficiently agree with *var. oblongifolia*, and it seems convenient to redefine this variety thus:

*var. velutina* (O. K.) BURK. *comb. nov.*—*D. pyrifolia* *var. oblongifolia* ULINE *ex* KNUTH, Pfl. R. 87 (1924) 275.

Leaves narrower than in the type. Male spikes longer and sometimes with the flowers spaced their own diameter apart.

#### Excluded and doubtful species

*Dioscorea aculeata* NAVES in NAVES and F. VILLAR, Novis. App. Fl. Filip. (1880) 260, from the island of Panay is probably *D. aculeata* L. (1754, not of 1753) and therefore would be *D. esculenta* BURK.

*Dioscorea batatas* NAVES, *op. cit.* 258, from Manila, would not be *D. batatas* DECNE (which is *D. opposita* THUNB.) and may represent *D. divaricata* BLANCO.

*Dioscorea bolonjonica* BLANCO, Fl. Filip. (1837) 800, ed. 2 (1845) 551, ed. 3, 3 (1879) 208 = *Pueraria phaseoloides* BENTH. (Legum.).

*Dioscorea eburnea* NAVES, *op. cit.* 260, from Antique, Philippines, as based on RUMPHIUS's Herb. Amb. is probably a clone of *D. alata* L.

*Dioscorea glabra* NAVES, *op. cit.* 258, from Boso-boso in Rizal Province, Luzon, as a misinterpretation of VIDAL's *no* 3932 would be *D. peperoides* PRAIN & BURK.

*Dioscorea globifera* R. KNUTH, Pfl. R. 87 (1924) 149 may represent *D. pentaphylla* L. *var. papuana* PRAIN & BURK. described above, p. 316.

*Dioscorea japonica* NAVES, *op. cit.* 259, certainly not *D. japonica* THUNB., is indeterminable.

*Dioscorea mindanaensis* R. KNUTH, Pfl. R. 87 (1924) 271; PRAIN & BURK. Ann. R. Bot. Gard.

Calc. 14 (1936) 70. The name is virtually a *nomen nudum*, the scrap to which it was given being inadequate even for the establishment of the section. But it is interesting to know that a *Dioscorea* occurs on the E. slopes of Mt Apo in Mindanao (S. Philippines) at the considerable height of 2000 m.

*Dioscorea oppositifolia* NAVES, *op. cit.* 258, from S. Mateo, near Manila and from the islands of Panay, Cebu and Negros, cannot have been *D. oppositifolia* L. and is indeterminable.

*Dioscorea repanda* BLUME, En. Pl. Jav. 1 (1827) 22 is an indeterminable immature condition of one of the species of section *Enantiophyllum*.

*Dioscorea spiculata* BLUME, En. Pl. Jav. 1 (1827) 22 *excl. obs. foliis oppositis, caule alato et syn. Rumph.*; MIQ. Fl. Ind. Bat. 3 (1859) 573 = according to HALLIER, Med. Rijksherb. Leiden 1 (1910) 40 = *Tinospora crispa* Miers = *Tinospora coriacea* (BL.) BEUMÉE *ex* HEYNE (Menispermaceae).

*Dioscorea verticillata* LAMK, Dict. Encycl. 3, 3 (1789) 231 = *Rubia cordifolia* L. (*Rub.*); cf. DAVEAU, Bull. Soc. Bot. Fr. 75 (1928) 254-256. This was based on a Javan specimen collected by COMMERSON.



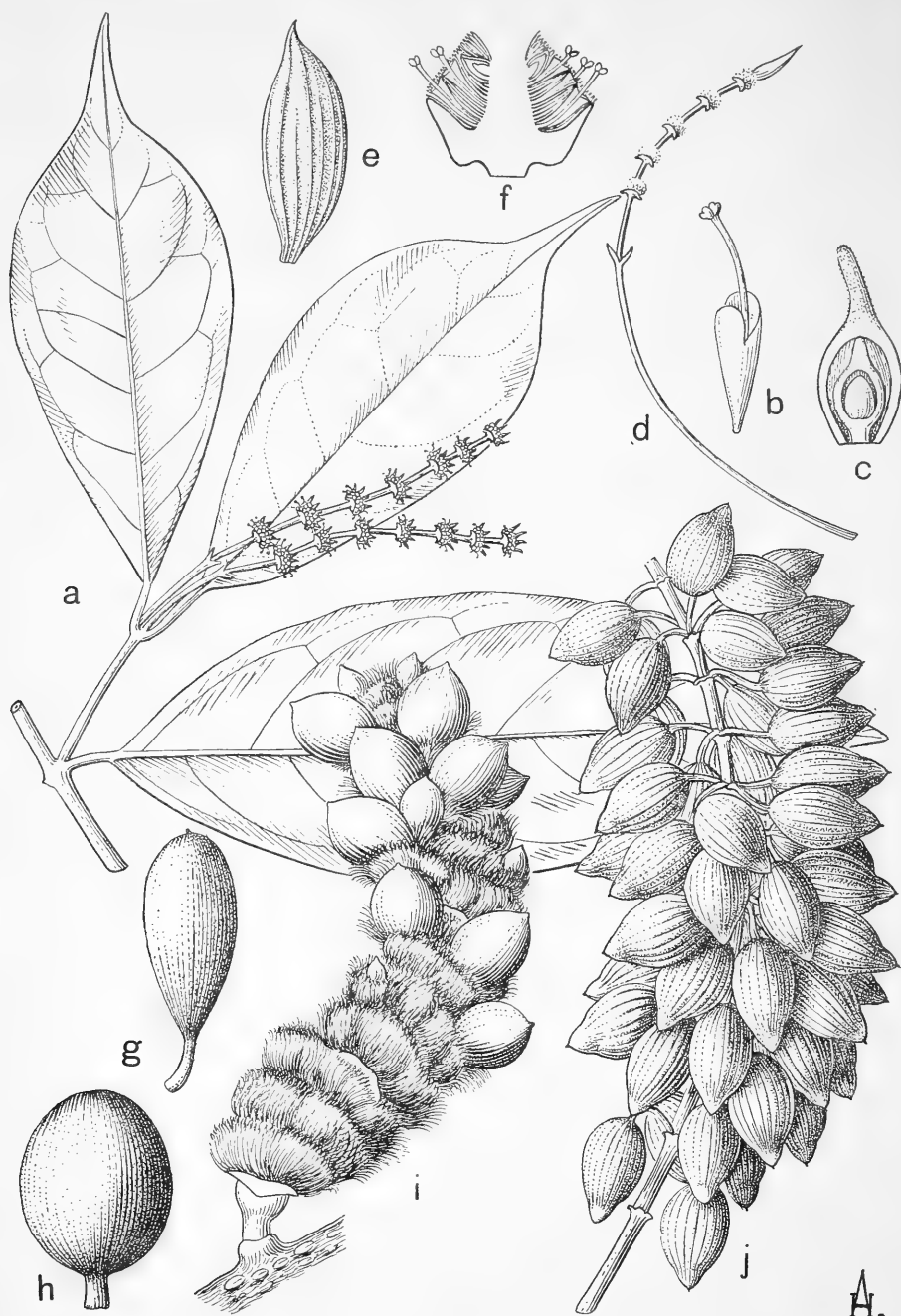


Fig. 1. a-e. *Gnetum costatum* K. SCH., f. *G. leptostachyum* BL., g. *G. latifolium* BL. var. *laxifrutescens* (ELM.) MGF, h. *G. latifolium* BL. var. *latifolium* f. *latifolium*, i. *G. macrostachyum* HOOK. f., j. *G. tenuifolium* RIDL. (a. ♂ flowering twig, b. ♂ flower,  $\times 10$ , c. sterile ♀ flower,  $\times 10$ , d. ♀ inflorescence, e. fruit, f. section of ♂ inflorescence,  $\times 8$ , g-h. fruit, i-j. infructescences).

## GNETACEAE (F. Markgraf, München)

### GNETUM

LINNÉ, Mant. ed. 1 (1767) 18; MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 407, map 1–8, t. 1–14; Pflanzenareale 3 (1932) map 31–40.

Glabrous trees, shrubs or, for the greater part, vines. *Leaves* decussate, simple, entire, penninerved, exstipulate, mostly provided with fine, pellucid lines (spicular cells) parallel to the secondary nerves and then bearded on fracture. *Spikes* ramified or simple, axillary or often cauline, dioecious, each one with 2 opposite basal scales and several collars containing moniliform hairs and sessile flowers, either numerous spirally arranged male ones below a ring of some sterile female ones, or a ring of few fertile female ones. ♂ *Flower*: a claw-shaped, transversely splitting perianth and a central stamen with 2 (in *G. gnemonoides* one) apical, yellow microsporangia that open by an apical median split. ♀ *Flower*: a fleshy outer envelop ('perianth') and 2 thin inner ones ('integuments'), the innermost with a long, slender, apical tube, and an orthotropous ovule; sterile ♀ flower without the middle envelop. *Fruit* pink (in *G. neglectum* and *G. oxycarpum* yellow), consisting of the fleshy outer envelop, which in some *spp.* is narrowed into a stalk, the hardened, ribbed middle envelop, the thin, silky, inner envelop, and a large, horny seed with small embryo.

*Distr.* About 30 species, of which 7 in northern S. America, 2 in western tropical Africa, the remainder in tropical Asia from Bombay to Fu-Kien, through *Malaysia* to Fiji, neither in Formosa nor in Australia or New Caledonia. Centre of present development: eastern *Malaysia*. The distributional areas of several species present some marked lines within the archipelago.

*Ecol.* All species inhabit the tropical rainforest below 1500 m altitude, except *G. microcarpum* which has been reported from Mt Tahan (Pahang, Mal. Pen.) at ca 2000 m. Large-leaved and -fruited taxa are produced in the moist air of mountain gorges. Small-leaved taxa occur both in the rain forest (*G. diminutum* and *G. microcarpum* f. *silvestre*) and in drier localities; examples of the first are represented by *G. montanum* f. *parvifolium* in E. China and *G. microcarpum* f. *campestre* in the Malay Peninsula, examples of the latter are *G. latifolium* var. *minus* and *G. leptostachyum* var. *abbreviatum*, all growing near the lower limit of the cloudy forest.

Most *Malaysian* species are tall lianas, but *G. costatum* and *G. gnemon* are arboreous, though the latter species is sometimes climbing as has repeatedly been reported from New Guinea.

According to RIDLEY (Disp. p. 240, 352) the pink fruits of *Gnetum* are dispersed by birds, but some are probably disseminated by water, e.g. *G. gnemonoides* with large corky fruits  $7\frac{1}{2}$  by  $3\frac{3}{4}$  cm. *Gnetum* seeds are sometimes found in excreta of civet-cats (*Viverridae*). HEMSLEY reported *Gnetum* seeds from the beach (Rep. Chall. 297).

*Uses.* The inner bark of several species, *G. gnemon*, *G. latifolium*, and others, is highly praised for its fibre, and is used all over *Malaysia* for twisting thread, string and cordage. The fibre is strong and durable in seawater and is mostly used for fishing nets and lines; in Papua carrying nets are made from it. If the fibre could be purified it would do exceedingly well for paper. *G. gnemon* is principally cultivated as a fruit tree, the embryo being pounded and eaten roasted, but also cooked in soup. Seeds of some other species are also used. The flush and inflorescences of *G. gnemon* are cooked in soup or eaten as vegetable which in the raw state causes a little itching in the mouth. Trees are sometimes coppiced for rapid production of flush. The only species really cultivated is *G. gnemon* var. *gnemon*; it is a straight tree, leafy from the base; it is sometimes planted in small orchards, but mostly in mixed gardens. It is found, outside Java, not rarely in old clearings and secondary forest (HEYNE, Nutt. Pl. 1927, p. 121–125).

*Wood anat.* DEN BERGER, Determinatietabel Houtsoorten van Malesië, Wageningen (1949) 35 (hand lens). LA RIVIÈRE, Ann. Jard. Bot. Buitenzorg 30 (1916) 23 (also bark anat.); fig. 10, pl. V and fig. 8, pl. VI are most probably representing rd. and tg. faces of disjunctive elements (in Dutch: conjugatiebuisjes). Wood especially of interest as it presents some angiospermous characters, cf. MACDUFFIE, Bot. Gaz. 71 (1921) 438, THOMPSON, Bot. Gaz. 65 (1918) 83.—C.A.R.-G.

*Vern.* *Mëlingdu*, *mëningo*, *génémo*, *tangkil*, *kliat* (all reported several times). See also under the separate species.

*Notes.* The family represents a peculiar climax of gymnosperms holding some characters of dicotyledons as well. The floral organs are interpreted in very different ways. The most recent review is given by FAGERLIND (Ark. för Bot. 33 A, 1946, no 8), who assumes the ♀ envelops to be composed of several leaves according to development comparable to that of the whole strobilus.

In collecting *Gnetum*, one should try to get both sexes in each locality and take care of the brittle inflorescences.

Some remarkable teratological foliar deviations have been described by COSTERUS & SMITH (Ann. Jard. Bot. Botz 33, 1923, 99–102), e.g. 4-whorled leaves and reduction of leaves to scales or thorns resembling those in *Ephedra*. Adventitious leaf-borne shoots have been studied by J. VAN BEUSEKOM (Thesis, Utrecht, 1907, pp. 141, t. 1–3); their origin is ascribed to the sting of a coccide. They were later reported from Java by VAN STEENIS (Trop. Natuur 28, 1939, 69, fig.). Sometimes the inflorescence collars are transformed into a continuous spiral band (THOMPSON, Amer. J. Bot. 3, 1916, 139–140).

#### KEY TO THE SPECIES (♂ plants)

1. Trees or shrubs, only occasionally and partly climbing. Leaves thin, yellowish when dried. Inflorescence yellowish; collars flat, almost always conspicuously distant from each other.
 

*Sect. Gnemonomorphi subsect. Eugnemones*
2. Trees. Sterile ♀ flowers ovate, long-beaked; beak finely velvety, whitish . . . . . **2. *G. costatum***
2. Trees or shrubs. Sterile ♀ flowers globose, tipped (only in *var. griffithii* beaked), the tip neither velvety nor whitish . . . . . **1. *G. gnemon***
3. Shrub. Inflorescences simple, tender, its axis scarcely 1/2 mm thick, flower clusters up to 2 mm in diam. . . . . *var. tenerum*
3. Trees or shrubs. Inflorescences simple or branched, thick, its axis 1 mm thick, flower clusters up to 5 mm in diam.
4. Trees. Inflorescences almost always branched, all collars distant . . . . . *var. gnemon*
4. Shrubs. Inflorescences always simple, often only the lowermost collars distant (inflorescence unknown in *var. gracile*).
5. All collars distant. Sterile ♀ flowers beaked (oblong, glabrous) . . . . . *var. griffithii*
5. Collars at least partly contiguous. Sterile ♀ flowers shortly acuminate.
6. Only the uppermost collars contiguous. Sterile ♀ flowers globose with short tip *var. brunonianum*
6. All collars contiguous or only the two lowermost distant. Sterile ♀ flowers tapering gradually.
 

*var. ovalifolium*
1. Lianas. Leaves brown or black when dry, coriaceous (thin only in *G. neglectum* and *G. tenuifolium*). Inflorescence not yellowish, its collars always fairly approaching each other (the axis never visible between them), their edges bent upward . . . . . *Sect. Cylirostachys* MGF
7. Collars of inflorescence dish-like, the flowers coming out freely.
8. Leaves with numerous spicular cells parallel to the secondary nerves, therefore silky above when dry. Stamen with one microsporangium only . . . . . **11. *G. gnemonoides***
8. Leaves with few or no spicular cells. Stamen with two microsporangia.
9. Leaves thin, green when dry, large, elliptic. Inflorescence simple (rarely once branched), slender (3 mm broad), spike itself 2 cm long . . . . . **3. *G. tenuifolium***
9. Leaves coriaceous. Inflorescence always branched.
10. Leaves small, obovate and tailed, distinctly reticulate, black when dry, striate above by spicular cells. Inflorescence once branched, slender (3 mm broad), spike itself 1–1 1/2 cm long.
 

**5. *G. arboreum***
10. Leaves often large and broad, not striate, mostly black when dry and inconspicuously reticulate. Inflorescence branched several times, thicker (4 mm broad), spike itself up to 4 cm long.
 

**4. *G. latifolium***

*var. funiculare*
11. Leaves elliptic, brown when dry, distinctly reticulate, secondary nerves distinctly joined.
 

*var. funiculare*
11. Dry leaves nigrescent, inconspicuously reticulate, secondary nerves ending open.
12. Leaves almost orbicular . . . . . *var. laxifrutescens*
12. Leaves elliptic.
 

**13. *G. minus***

**13. *G. latifolium***
7. Collars of inflorescence cylindric, keeping the flowers enclosed.
14. Inflorescence branched, mostly large (unknown in 9. *G. ridleyi* from Pahang, but ♀ ones of this type), with often very long stalks (in *var. abbreviatum* short) . . . . . **16. *G. leptostachyum***
14. Inflorescence unbranched, often cauline.
15. Leaves thin, tapering at both ends (inflorescence unknown, but the ♀ one is simple and slender).
 

**6. *G. neglectum***
15. Leaves coriaceous. Inflorescence thick (4–5 mm).
16. Inflorescence 6 cm long, drooping (unknown in 8. *G. klossii* from Borneo, but its rough ♀ one is of this type). Flowers numerous, embedded in many hairs . . . . . **7. *G. cuspidatum***
16. Inflorescence short (2–3 cm), mostly erect.
17. Inflorescence very thick (7 mm). Leaves large.
18. Leaves oblong-obovate, somewhat silky above by spicular cells. Flowers immersed into few hairs . . . . . **10. *G. loerzingii***
18. Leaves elliptic, not silky. Flowers immersed into numerous long hairs **13. *G. macrostachyum***

17. Inflorescence moderately thick (4 mm), shortly stalked, mostly upright. Leaves small, up to 15 cm long.
19. Leaves firm (not fleshy), with distinct nervation, not glaucous, not cuneate. Inflorescence 3 cm long . . . . . 12. *G. diminutum*
19. Leaves fleshy, with indistinct nervation, more or less glaucous. Inflorescence 1½–2 cm long.
20. Leaf base mostly acute, leaves often lanceolate. Collars of inflorescence with angular lower edge . . . . . 14. *G. microcarpum*
20. Leaf base mostly rounded. Collars of inflorescence with vaulted lower edge. . . . . 15. *G. oxycarpum*

## KEY TO THE SPECIES (♀ plants)

1. Trees and shrubs, only occasionally or partly climbing. Leaves thin, yellowish when dry. Inflorescence yellowish, collars flat. Fruit almost velvety.
2. Tree. Flowers ovate, long-beaked; beak finely velvety, whitish . . . . . 2. *G. costatum*
2. Tree or shrub. Flowers globose, shortly tipped (only in *var. griffithii* beaked), the tip not velvety nor whitish . . . . . 1. *G. gnemon*
3. Collars of inflorescence remote.
4. Flowers globose. Fruit ovate, obtuse.
5. Tree. Inflorescence mostly branched, all its internodes long (1½–1 cm). Fruit large (2 cm long). . . . . *var. gnemon*
5. Shrub. Inflorescence simple, at least its two lowermost internodes long, all others short and hidden. Fruit small (1 cm long), inserted on a thickened rhachis . . . . . *var. brunonianum*
4. Flowers oblong, beaked (unknown in *var. gracile*). Fruit acute.
6. Fruit oblong. Axis of inflorescence thick (1 mm); internodes ½ cm long . . . . . *var. gracile*
6. Fruit ovate. Axis of inflorescence slender (½ mm); internodes 1½ cm long . . . . . *var. tenerum*
3. Collars of inflorescence contiguous. Inflorescence short. Flowers acute.
7. Flowers globose, beaked. Fruit globose . . . . . *var. griffithii*
7. Flowers ovate, acuminate. Fruit ovate, long-acute . . . . . *var. ovalifolium*
1. Lianas. Leaves coriaceous, brown or black when dry (thin only in *G. neglectum* and *G. tenuifolium*). Inflorescence not yellowish. Collars dish-like. Fruit smooth or warty, not velvety. *Sect. Cyliandrostachys*
8. Inflorescence branched (unknown in 5. *G. arboreum*, but the male one branched, small).
9. Leaves obovate-cuneate, tailed, small, distinctly nerved below, densely striate by spicular cells above. Fruit long-stalked . . . . . 5. *G. arboreum*
9. Leaves broadest in or below the middle, mostly large, not densely striate above.
10. Leaves brown when dry, secondary nerves distinctly joining.
11. Nerves all remote, arcuate. Inflorescence rich and spreading, often 30 cm long, in *var. abbreviatum* much shorter. Flowers globose, shortly tipped, embedded in dense hairs. Fruit sessile . . . . . 16. *G. leptostachyum*
11. Secondary nerves at the leaf base approaching each other, all with a straight lower part. Inflorescence not so rich, 15 cm long. Flowers obliquely beaked, conical, embedded in few hairs. Fruit stalked . . . . . 4. *G. latifolium* *var. funiculare*
10. Leaves black when dry, secondary nerves indistinctly joining.
12. Leaves with conspicuous spicular cells, though not striate. Flowers embedded in numerous hairs. Fruit very large (6 cm), obtusely turbinate, sessile . . . . . 9. *G. ridleyi*
12. Leaves without conspicuous spicular cells. Flowers not embedded in numerous hairs. Fruit elliptic, up to 2½ cm long, stalked . . . . . 4. *G. latifolium*
13. Leaves almost or quite orbicular. Fruit oblong-obovate, rather long-stalked. . . . . *var. laxifrutescens*
13. Leaves elliptic. Fruit stalk thick.
14. Leaves small (not longer than 9 cm). Fruit ovate, small (1½ cm long) . . . . . *var. minus*
14. Leaves large. Fruit large, 2–2½ cm, broadly ovate, long- or short-stalked . . . . . *var. latifolium*
8. Inflorescence simple (exceptionally once branched in *G. neglectum*).
15. Leaves thin, tapering at both ends. Secondary nerves straight and broken.
16. Secondary nerves remote but not extremely so. Spike short (4 cm). Collars contiguous. Fruit 2 cm long, longitudinally furrowed, acute, with a long, slender stalk . . . . . 3. *G. tenuifolium*
16. Secondary nerves extremely remote (up to 3 cm). Spike long, 8 cm. Collars not contiguous. Fruit small, brownish yellow, sessile, smooth, obtuse, 1½ cm long . . . . . 6. *G. neglectum*
15. Leaves coriaceous, secondary nerves bent, not broken.
17. Leaves silky above by numerous parallel spicular cells. Flowers obtuse. Fruit obtuse, large, warty. . . . . 11. *G. gnemonoides*
17. Leaves not silky by spicular cells. Flowers acuminate. Most inflorescences cauline.
18. Leaves fleshy, with indistinct nervation, more or less glaucous.
19. Flowers ovate. Fruit more or less obtuse, yellow, 2 cm long . . . . . 14. *G. microcarpum*
19. Flowers oblong-conical. Fruit long-acuminate, 2½ cm long, pink . . . . . 15. *G. oxycarpum*
18. Leaves firm, not fleshy, not glaucous, with distinct nervation.

20. Leaves obovate-cuneate, striate above by spicular cells. Flowers obtuse, not embedded in thick hair masses. Fruit obtuse, 4 cm long . . . . . 10. *G. loerzingii*
20. Leaves elliptic, not striate above. Flowers embedded in thick hair masses.
21. Leaves broad-elliptic. Fruit large, acute, rough . . . . . 8. *G. klossii*
21. Leaves twice as long as broad. Fruit not rough.
22. Collars contiguous, their hair tufts enormous. Fruit small, up to 2 cm long, almost globose. 13. *G. macrostachyum*
22. Collars remote, hair tufts large, but not enormous.
23. Leaves large. Inflorescence elongate. Fruit shining, large, broad-ovate, 2½ cm long, 1½ cm broad . . . . . 7. *G. cuspidatum*
23. Leaves small. Inflorescence short. Fruit small, elliptic, 1½ cm long, 8 mm broad. 12. *G. diminutum*

### Section Gnemonomorphi

MGF in E. & P. ed. 2, 13 (1926) 440; Bull. Jard. Bot. Btzig III, 10 (1930) 435.

Male inflorescences with visible internodes between the collars (though very short in the shrubby *G. gnemon* var. *griffithii* & var. *ovalifolium*).

### Subsection Eugnemes

MGF *l.c.*

Leaves thin. Trees and shrubs, only exceptionally climbing. Dried leaves and inflorescences yellowish. Fruits finely velvety (except in *G. gnemon* var. *tenerum*).

1. *Gnetum gnemon* LINNÉ, Mant. 1 (1767) 125; MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 436; BURK. Dict. (1935) 1091; CORNER, Wayside Trees (1940) 726, pl. 227–228.—*G. acutatum* MIQ. Fl. Ind. Bat. Suppl. (1860) 251, 588.—*G. vinosum* ELM. Leaf. Philip. Bot. 7 (1915) 2673.

Tree or shrub, up to 22 m tall, 40 cm diam., without buttresses, exceptionally a climbing shrub. Crown monopodial, narrow, cylindrical; trunk grey, marked with conspicuous or faint rings. Leaves thin, yellow when dry, tapering at both ends, but varying in shape and size, 7½–20 by 2½–10 cm; secondary nerves bent, joining; petiole 6–18 mm. ♂ Inflorescences solitary, axillary, simple or once branched, yellowish, 3–6 cm long, collars 3 mm broad. ♂ Flowers with broad sporophyll, twice as long as the perianth (3 mm). Sterile ♀ flowers globose, tipped or beaked, 2 mm thick, 10–15 in a ring. ♀ Inflorescences similar. ♀ Flowers 5–8 at each node, globose, tipped or beaked, 3–4 mm long, inner tube exerted by 1 mm. Fruit ripening yellow, then orange-yellow or pink, sessile (exceptionally stalked), ellipsoid, shortly apiculate, 1–3½ cm long, almost velvety; middle envelop ribbed.

Distr. From Assam throughout *Malaysia* to Fiji, but not native in the Andaman Islands, Sumatra, and Java.

Ecol. In rainforest at lower altitudes, but shrubby varieties ascending up to 1500 m in India.

Uses. Young leaves and inflorescences are eaten as vegetable, fruits are also edible.

Vern. *Génemo*, *rukiti* (Moluccas), *mēlindju*, *malinju*, *M. garintul*, *J. sabé*, *tankil*, *S. mēninjau*, *bēlinjau*, *songkok* (Mal. Pen.). New Guinea: *tu-a* (Suku), *suffitz* (Yalu), *genda* (Buna), *doro* (Vailala).

var. *gnemon*.—var. *laurinum* BL. Rumphia 4 (1848) p. 3, t. 176, var. *lucidum* BL., var. *majusculum*

BL.; MIQ. Fl. Ind. Bat. 2 (1856) 1067.—*Gnemon domestica* RUMPH. Herb. Amb. 1 (1741) 181, t. 71, 72.—var. *domesticum* MGF, *l.c.* 437, t. 1, fig. 7 incl. f. *vo ubile* & *stipitatum* MGF; CORNER, Gard. Bull. S.S. 10 (1929) 247.—*Gnetum vinosum* ELM. Leaf. Philip. Bot. 7 (1915) 2673.

Tree. Collars remote, axis often once branched. ♀ Flowers shortly tipped. Fruit large, 2–2½ cm long.

Distr. Fiji and Solomon Islands to *Malaysia*: from Sumba and Celebes through the Philippines to New Guinea, the Malay Peninsula, and possibly elsewhere, often planted and frequently naturalized in secondary forests, even in W. *Malaysia*. Fig. 2.

Ecol. High tree in rainforest at lower altitudes, below 1000 m, not rare.

Use. Fruit eaten, young leaves eaten as a vegetable.

Vern. *Génemo* (Alf.), *saédé* (Talaud), *rukiti* (Morotai), *kaikai* (Celebes), *andēpi* (S. New Guinea).

var. *brunonianum* (GRIFF.) MGF, *l.c.* 440, t. 1, f. 6b; CORNER, Wayside Trees (1940) 726.—*G. brunonianum* GRIFF. Not. Pl. As. 4 (1854) 30–31.

Shrub, 0.6–3 m. Collars remote, only the uppermost ones contiguous, axis unbranched; ♀ flowers shortly tipped; fruit small, 1 cm long.

Distr. Assam, Burma, Tenasserim and W. *Malaysia*: Malay Peninsula, Anambas Islands, Karimata Islands, NW. Borneo. Fig. 2.

Ecol. Ascends into the mountain rainforest, often to 1200 m, in Perak up to 1500 m.

Vern. *Chēpērai* (Johore), *mēliling* (Raub).

var. *griffithii* (PARL.) MGF, *l.c.* 442, t. 1, f. 5, 6–6b.—*G. griffithii* PARL. in DC. Prod. 16, 2 (1868) 349.

Shrub. Collars all remote, though often not far. ♀ Flowers beaked, oblong. Fruit small, globose. Leaf margins often parallel.

Distr. Assam, Burma, Lushai, Annam and Tenasserim to *Malaysia*: Malay Peninsula. Fig. 2.

Ecol. Ascends into the mountain rainforest as well (Assam 1500 m).

var. *ovalifolium* (POIR.) BL. Ann. Sc. Nat. II, 2 (1834) 105.—*Gnemon silvestris* RUMPH. Herb. Amb. 1 (1741) 183, t. 73.—*Gnetum ovalifolium* POIR. in LAMK, Encycl. Suppl. 2 (1811) 810.—*G. silvestris* BRONGN. in DUPEYREY, Voy. Coquille (1829) 12.—*G. gnemon* var. *silvestris* PARL. in DC. Prod. 16, 2 (1868) 349; MGF, l.c. 443, f. 1, 2–2a.

Collars all contiguous or only the 2 lowermost remote, axis unbranched.

Distr. From the Fiji Islands to *E. Malaysia*: westwards to Celebes, rare. Fig. 2.

Uses. Fibres used for nets and ropes.

Vern. *Mariwa* (Solomons), *saédé* (Talaud), *mulai* (New Ireland).

var. *tenerum* MGF, l.c. 444, t. 1, f. 3–4.

Shrub or small tree, 3 m tall. Inflorescence very slender, collars remote. ♀ Flowers gradually tapering. Fruit small, 1½ cm long, ovate, acute.

Distr. *Malaysia*: Malay Peninsula (from Pahang southward), Borneo. Fig. 2.

var. *gracile* MGF, l.c. 444, t. 1, f. 1a.

Shrub. Leaves small, not longer than 9 cm.

Inflorescence slender, collars few, remote. Fruit small, oblong.

Distr. SW. & Central Celebes (Makassar, Malili). Fig. 2.

2. *Gnetum costatum* K. SCH. in K. SCH. & HOLLER. Fl. Kais. Wilh. Land (1889) 13; MARKGRAF, Bot. Jahrb. 60 (1925) 147; WHITE, J. Arn. Arb. 10 (1929) 201; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 445, t. 1, f. 7–12.—Fig. 1a–e.

Tree, ca 20 m high. Leaves thin, but slightly thicker than in *G. gnemon*, yellowish when dry, tapering at both ends, large (15–18 cm long), petiole short (½ cm), secondary nerves bent, joining. ♂ Inflorescences solitary, axillary, simple, yellowish, 6–7 cm long, collars remote, 3 mm broad; ♂ flowers with tender, long-exserted sporophyll; sterile ♀ flowers ovate, beaked, finely whitish-pubescent, up to 10 in a ring. ♀ Inflorescences similar, their flowers immersed in dense whitish hairs. ♀ Flowers long-acuminate, finely whitish-pubescent. Fruit red or pink, obliquely fusiform, 4 cm long, 1 cm thick, conspicuously tapering at the base, sharply acuminate at the top, its outer envelop fleshy but thin, the longitudinal ribs of the hard middle one visible therefore in the dry state already from the outside. Seed fusiform, furrowed.

Distr. Solomon Islands (Bougainville, Malaita, only ♂), in *Malaysia*: E. New Guinea. Fig. 2.

Ecol. In rainforest, at low altitudes up to 1350 m, not in swamps.

Vern. *Böiwa* (Waria region), *kem*, *roro*, *haboi*.

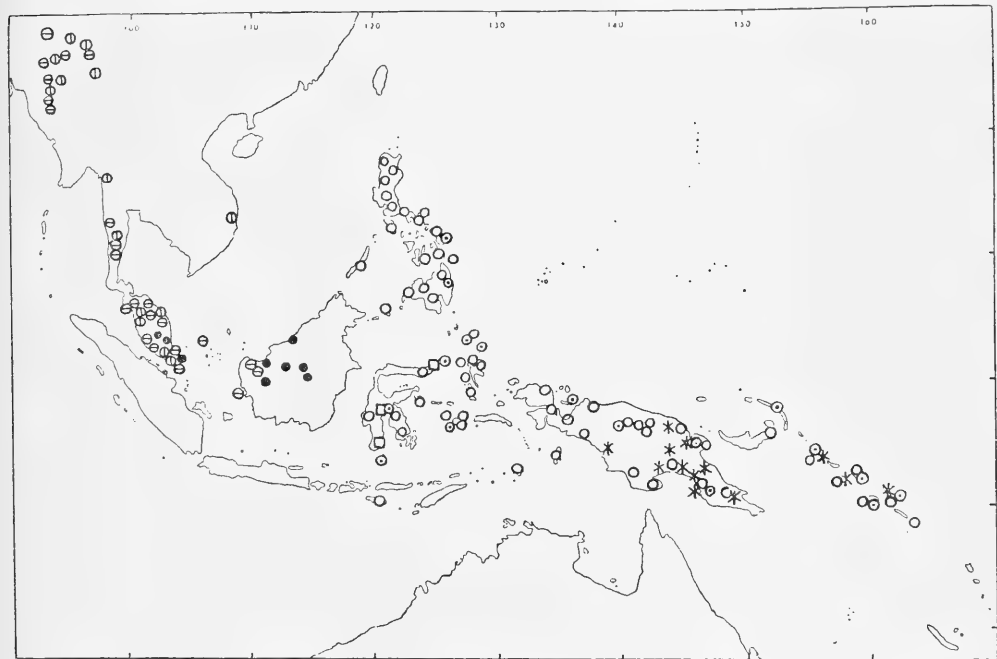


Fig. 2. Distribution of ★ *Gnetum costatum* K. SCH. and different varieties of *G. gnemon* L. viz ⊖ var. *brunonianum* (GRIFF.) MGF, ⊕ var. *griffithii* (PARL.) MGF, ● var. *tenerum* MGF, □ var. *gracile* MGF, ⊙ var. *ovalifolium* (POIR.) BL., ○ var. *gnemon*.

Section *Cylindrostachys*

MGF in E. & P. ed. 2, 13 (1926) 440; Bull. Jard. Bot. Btzig III, 10 (1930) 455.

Male inflorescences without visible internodes between the collars. Dried leaves never yellowish. Fruits never velvety. Lianas.

Subsection *Stipitati*

MGF, Bull. Jard. Bot. Btzig III, 10 (1930) 455.

Male collars flat, their margins bent outward, allowing the flowers to come out freely in anthesis and distinctly visible before anthesis. Fruits stalked.

3. *Gnetum tenuifolium* RIDL. J. Str. Br. R. As. Soc. 59 (1911) 188; *ibid.* 60 (1911) 66; Fl. Mal. Pen. 5 (1925) 277; MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 456, t. 6, f. 5-10.—Fig. 1j.

Leaves thin, green when dry, tapering at both ends, large, up to 24 cm; secondary nerves bent, joining. ♂ Inflorescences erect, simple or once branched, slender; spike 2 cm long. ♂ Flowers short, 1½ mm. Sterile ♀ flowers 6-10 in each collar, ovate, low. ♀ Inflorescences erect, simple; spike 4 cm long; collars very close to each other. ♀ Flowers 6-10, fusiform, 2 mm long, tube of innermost envelop 2 mm exerted. Fruits in a dense spike, 2 cm long, elliptic, acute, furrowed lengthwise, their outer envelop comparatively thin, fibrous, middle one ribbed, hard but also thin. Seed apiculate.

Distr. *Malaysia*: Malay Peninsula, Sumatra. Fig. 3.

Ecol. Rainforests at low altitudes.

4. *Gnetum latifolium* BL. Tijds. Nat. Geschied. & Phys. 1 (1834) 160; Ann. Sc. Nat. II, 2 (1834) 105; Rumphia 4 (1848) 5, 7, t. 174; MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 458.—*G. indicum* (LOUR.) MERR. Interpr. Rumph. Herb. Amq. (1917) 77, partly!—*G. philippinense* (non WARB.) Foxw. Philip. J. Sc. 6 (1911) 175.—Fig. 1g-h.

Large liana. Leaves dark green, black when dry, leathery, of variable shape; secondary nerves bent, running out inconspicuously, not joining, the 2-3 lowermost approximate, tertiary venation indistinct (distinct only in the brown-drying *var. funiculare*). ♂ Inflorescences lax, branched, most so if cauliflorous, up to 12 cm long; spikes 4 cm long, 4 mm broad, their collars open. ♂ Flowers numerous (about 50), sporophyll 3 mm long, half exerted, the 2 sporangia narrow. Sterile ♀ flowers 6-8 in each collar, broadly conical. ♀ Inflorescences similar, up to 15 cm long, their spikes 8 cm long, their collars 3 mm spaced. ♀ Flowers 6-9, acuminate and bent upward, 4 mm long, inner envelop rather deeply split. Fruit pink, ellipsoidal, 1½-2½ by 1-1½ cm, distinctly stalked (axis of inflorescence elongated up to 30 cm); outer envelop shining, fleshy, fibrous, 2 mm in diam., middle one hard but thin, inner one papery. Seed broad-oblong.

Distr. From the Andamans, peninsular Siam and Tonkin throughout *Malaysia* to New Ireland, not yet found in the Lesser Sunda Islands.

Ecol. Rainforest, ascending to 1800 m in Borneo, not rare.

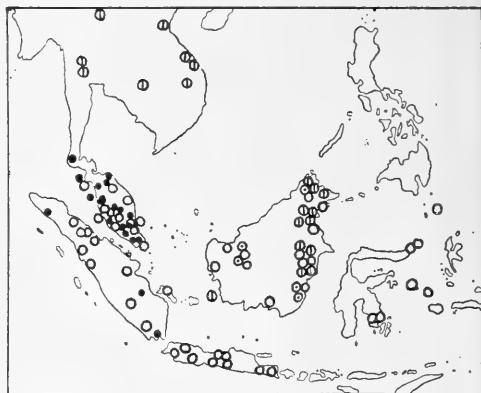


Fig. 3. Distribution of ● *G. tenuifolium* RIDL., ○ *G. cuspidatum* BL., ⊙ *G. diminutum* MGF, ⊗ *G. leptostachyum* BL.

Use. Bark fibre is used for making ropes and nets.

Vern. *Akar leia* (Bunguran).

*var. latifolium*.—*var. blumei* MGF, Bull. J.B.B. III, 10 (1930) 459, t. 7, f. 1.

Leaves elliptic, black when dry, nerves not joining. Spike 2-4 cm long. Fruit stalk thick, almost never longer than half as long as the fruit.

Distr. Cochinchina and throughout *Malaysia*.

Vern. *Tangkil, tranquil* (Java); *akar tutubo, akar suburus* (Mal. Pen).

*f. latifolium*.—*var. brachypodum* MGF, *l.c.*, t. 1, f. 6.—Fig. 1h.

Fruit of the broadest type, sometimes almost globose, obtuse, four times as long as its stalk.

Distr. *Malaysia*: rather frequent in the Philippines, also in New Guinea.

*f. longipes* MGF, *l.c.*, t. 7, f. 7.

Fruit large, somewhat attenuate, not longer than its stalk.

Distr. Indo-China and *Malaysia*: Philippines (Luzon) and New Guinea.

*var. laxifrutescens* (ELM.) MGF, Bot. Jahrb. 60 (1925) 148; Bull. J.B.B. III, 10 (1930) 463, t. 7, f. 8-10.—*G. laxifrutescens* ELM. Leaf. Philip. Bot. 4 (1912) 1478.—*G. latifolium var. peekelii* MGF, Bot. Jahrb. 60 (1925) 148.—Fig. 1g.

Leaves broad-elliptic, almost orbicular, black

when dry. Fruit claw-shaped, twice as long as broad, tapering into the stalk.

Distr. Melanesia (New Ireland, New Britain), in Malaysia: Philippines & Moluccas (Kei & Tanimber Isl.).

var. *minus* (FOXW.) MGF, Bull. J.B.B. III, 10 (1930) 463.—*G. minus* FOXW. Philip. J. Sc. 6 (1911) 176, t. 33.

Leaves small, not longer than 9 cm, elliptic. ♂ Spikes only 1½ cm long. Fruit small, 1½ cm long, four times as long as its stalk.

Distr. Indo-China, in Malaysia: Borneo (Kinalu), Philippines, SE. Celebes.

Ecol. In Borneo up to 1500-1800 m.

var. *funiculare* (BL.) MGF, Bull. J.B.B. III, 10 (1930) 463.—*G. funiculare* BL. Tijds. Nat. Geschied. & Phys. 1 (1834) 162; Ann. Sc. Nat. II, 2 (1834) 106; MIQ. Fl. Ind. Bat. 2 (1856) 1068, Suppl. (1860) 252; PARL. in DC. Prod. 16, 2 (1868) 351; KARSTEN, Ann. Jard. Bot. Btzg 11 (1893) 210, t. 17, f. 5.—*G. edule* BL. Tijds. Nat. Geschied. 1 (1834) 161; Ann. Sc. Nat. II, 2 (1834) 106.—*G. neglectum* (non BL.!) KARSTEN, Bot. Zeit. 50 (1892) 206.—*G. ula* (non BRONGN.!) KARSTEN, Ann. Jard. Bot. Btzg 11

(1893) 211, t. 18, f. 7, 10.—*G. kingianum* GAMBLE, Kew Bull. (1915) 92; RIDL. Fl. Mal. Pen. 5 (1925) 276.

Leaves brown when dry, nerves distinctly joining, tertiary venation distinct, reticulate; blade elliptic, large.

Distr. Peninsular Siam to Malaysia: through the Malay Peninsula and the islands round Sumatra (Banka, Lingga, Riouw, Simalur) to Java.

Vern. *Areuj kasungka*, S, *tangkil*, J.

5. *Gnetum arboreum* FOXW. Philip. J. Sc. 6 (1911) 174, t. 32; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 472, t. 6, f. 11-14.

Twigs conspicuously lenticellate. Leaves obovate-cuneate, small, up to 8 cm long, long-petiolate, leathery, brown when dry; secondary nerves 4-5 pairs, joining, tertiary ones distinct, reticulate. ♂ Inflorescences short, once branched; spikes 1-1½ cm long, 3 mm broad. ♂ Flowers few, scarcely 1 mm long; sporophyll 2½ mm long, thick. Sterile ♀ flowers about 8, narrow, their inner envelop not split. ♀ Inflorescences unknown. Fruit-bearing axis 4 cm long; collars 5 mm spaced. Fruit broad-elliptic, tipped, 2½ cm long, not shining, stalk 2 cm long, outer envelop fleshy but thin.

Distr. Malaysia: Philippines (Luzon). Fig. 4.

### Subsection Sessiles

MGF, l.c. 472.

Collars of male inflorescences cylindric, not bent outward (except in *G. gnemonoides*), so that in anthesis the flowers must force their way out. Fruits sessile.

6. *Gnetum neglectum* BL. Rumphia 4 (1848) 6, t. 175, f. 2, s. str.; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 473, t. 9, f. 13-16.

Small liana. Leaves papery, not shining, lanceolate-elliptic, tailed, up to 23 by 9 cm, changing from yellowish to black when dried; secondary nerves straight, broken before the margin, joining, very distant from each other, up to 3 cm; petiole rather long, ca 2 cm. ♂ Inflorescences unknown. ♀ Inflorescences unbranched or once branched, slender, 8 cm long; collars 3 mm spaced. ♀ Flowers globose, apiculate, immersed in a dense hair cushion, 5-6 in each collar. Fruits elliptic, obtuse, not shining, yellowish-brown, 1½ cm long, 8 mm thick, whorls spaced ca 8 mm on the slender axis; outer envelop rather thin-fleshy, middle one leathery, inner one papery.

Distr. Malaysia: Borneo. Fig. 4.

Ecol. Small climber of swampy rain forests at low altitudes.

Note. BLUME and most other authors have partly mixed this species with *G. cuspidatum* BL. Male plants are very much desired.

7. *Gnetum cuspidatum* BL. Rumphia 4 (1848) 5; MIQ. Fl. Ind. Bat. 2 (1856) 1067, Suppl. (1860) 252, 588; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 475, t. 10, f. 1-8.—*G. neglectum* var. *procerum* BL. et var. *macrostachyum* BL. l.c. 6.—*G. longispica* RIDL. J. Str. Br. R. As. Soc. 60 (1911) 63.—*G. penangense* RIDL. l.c.

Liana with flattened, woody stems. Leaves leathery, brown or blackish when dry, oblong-elliptic, up to 25 by 10 cm, often much smaller; secondary nerves bent, distinctly joining, rather distant from each other, tertiary nerves indistinct. ♂ Inflorescences cauline, simple, thick, about 6 cm long, 5 mm thick, pendulous. ♂ Flowers numerous, 80-100, obconic, 2 mm high; sporophyll exerted by 1 mm; sterile flowers 10, acute, ovate. ♀ Inflores-

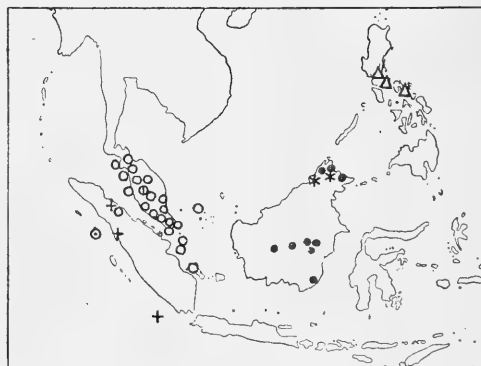


Fig. 4. Distribution of Δ *G. arboreum* FOXW., ★ *G. klossii* MERR., ● *G. neglectum* BL., + *G. loerzingii* MGF, ⊙ *G. oxycarpum* RIDL., ⊕ *G. ridleyi* GAMBLE, ○ *G. microcarpum* BL.



*ences* cauline, thick, pendulous, 5 cm long, collars 5 mm spaced. ♀ Flowers 5–7 to each collar, embedded in a dense, long hair tuft, broadly ovate, 5 mm long, inner envelop  $2\frac{1}{2}$  mm exserted, split. *Fruits* sessile on an elongated axis up to 15 cm, ellipsoid, shining, up to 3 cm long and half as broad, sometimes with a basal cushion; outer envelop fleshy and fibrous, middle one firmly papery, innermost papery.

Distr. Peninsular Siam, in *Malaysia*: Malay Peninsula, Sumatra, Banka, Java, Borneo, Celebes, Talaud Islands, Moluccas (Sula Isl.), and New Guinea, not in the Lesser Sunda Islands. Fig. 3.

Ecol. Rather common in rainforest, up to 1600 m.

Vern. *Kēliat* (Celebes), *baranggo* (Talaud), *akar katankil* (Banka).

8. *Gnetum klossii* MERR. ex MARKGRAF, Bull. Jard. Bot. Btzig 10 (1930) 478, t. 11, f. 6–8.

Liana. *Leaves* leathery, brown when dry, elliptic, not tailed, about 22 cm long, 11 cm broad, secondary nerves bent, indistinctly joining, tertiary nerves finely reticulate. *Inflorescences* unknown. Fruiting axes simple, cauline, 20 cm long, with thick, rough, 2 cm long internodes. Unpollinated ♀ flowers in a dense hair tuft, 5 mm long, broadly ovate; outer envelop rough, very fleshy, middle and inner ones papery. *Fruit* obovate-oblong, obtuse, to 5.3 cm long,  $1\frac{1}{2}$ –3 cm diam., rough by warty warts formed by protruding, flabellate epidermal cells; outer envelop moderately fleshy, middle one leathery and indistinctly ribbed, inner one papery. Seed 3 cm long.

Distr. *Malaysia*: NE. Borneo (Sandakan and Mt Kinabalu). Fig. 4.

Note. The surface of branches, inflorescences, flowers, and fruits is so characteristic, that it should be easy to recognize male plants.

9. *Gnetum ridleyi* GAMBLE ex (BURKILL & HENDERSON, Gard. Bull. S. S. 3, 1925, 458, *nomen*) MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 479, t. 11, f. 5.

Stout climber. *Leaves* leathery, elliptic, black when dry, up to 18 by 9 cm, transversely striate above by some fibres; secondary nerves straight, directed forward, indistinctly joining, tertiary ones reticulate. ♂ *Inflorescences* unknown. ♀ *Inflorescences* cauline, large, 16 cm long, 18 cm wide, branched twice or three times, spike 8 cm long, collars numerous. ♀ Flowers 6–8 to each collar, immersed in dense hair tufts, broadly ovate, their outer envelop containing many fibres. *Fruits* large, 5–6 cm long,  $2\frac{1}{2}$  cm thick, ellipsoidal, tapering to both ends, sessile, but by means of a basal cushion, obtuse; outer envelop fleshy and very fibrous, middle one slightly woody, with longitudinal ribs, inner one papery, fibrous. Seed 3 cm long.

Distr. *Malaysia*: Malay Peninsula (Pahang: Telom), rare. Fig. 4.

10. *Gnetum loerzingii* MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 480, t. 12, f. 8–10.

Liana. *Leaves* obovate, cuneate, leathery, up to

16 by 6 cm, brown when dry; secondary nerves bent, indistinctly joining, tertiary ones inconspicuous, upper leaf surface transversely striped by fibres. ♂ *Inflorescences* axillary, erect, once branched, thick, 3 cm long, 7 mm broad. ♂ Flowers broadly obconic; sterile ♀ flowers ovate. ♂ *Inflorescences* unknown. Internodes of fruit-bearing axis  $1\frac{1}{2}$  cm long, 4 mm thick; unpollinated flowers 6 in each collar, ovate. *Fruits* wine-red, obovate-ellipsoid, not shining,  $4\frac{1}{2}$  by  $2\frac{1}{2}$  cm; outer envelop fleshy, middle one woody and fibrous, inner one papery. Seed oblong, striped, 24 mm long.

Distr. *Malaysia*: N. Sumatra and Enggano Island. Fig. 4.

11. *Gnetum gneumonoides* BRONGN. in DUPERREY, Voy. Coquille (1829) 12; MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 480, t. 13.—*Funtis gneumoniformis* RUMPH. Herb. Amb. 5 (1747) 11, t. 7.—*Gnetum rumphianum* BECC. *Malesia* 1 (1877) 182.—*G. macrocarpum* BECC. *L.c.*—*G. ovalifolium* (non POIR.) KARST. Ann. Jard. Bot. Btzig 11 (1893) 215.—*G. verrucosum* KARST. *L.c.* 216.—*G. molucense* KARST. ex MGF in E. & P. Nat. Pfl. Fam. ed. 2, 13 (1926) 435.—*G. kerstingii* LAUT. in K. SCH. & LAUT. Fl. D. Schutzgeb. Südsee (1901) 157.—*G. wrayi* GAMBLE, Kew Bull. (1915) 92.—*G. edule* (non BLUME) HASSK. Abh. Naturf. Ges. Halle 9 (1866) 231.—Fig. 5.

Liana. *Leaves* coriaceous, yellowish-brown when dry, elliptic, up to 20 cm long, 8 cm wide, but mostly short, upper surface silky by means of a transverse striping by densely set fibres; secondary nerves straight, joining at a conspicuous distance before the margin, tertiary nerves reticulate below. ♂ *Inflorescences* axillary, branching once, spikes about 2–3 cm long, 4 mm thick; collars bent outward by their upper edges. ♂ Flowers numerous, narrowly obconic,  $1\frac{1}{2}$  mm long; sporophyll filiform,  $2\frac{1}{2}$  mm long, with only one sporangium. Sterile ♀ flowers 8 to each collar, globose, apiculate. ♀ *Inflorescences* axillary, not branching; spike 4 cm long; collars densely approximate. ♀ Flowers 4–6 to each collar, ovate-globose, rather obtuse, outer envelop fleshy and fibrous, tube of the inner one not split. *Fruits* sessile on a much thickened axis, 5–6 cm long, 2 cm thick, ellipsoidal, obtuse, tapering into a basal cushion, shining, but very warty; outer envelop very thick, 5 mm, fleshy, very fibrous, middle one woody, conspicuously ribbed, inner one papery. Seed oblong,  $3\frac{1}{2}$  cm long.

Distr. New Hanover, in *Malaysia*: Malay Peninsula (Taiping), Billiton, Borneo, Celebes, Philippines (rare), Moluccas (Aru Islands), New Guinea. Absent from the outer arch of islands (Sumatra, Java, Lesser Sunda Islands).

Ecol. In rainforests at low altitude, up to 300 m.

Vern. *Rukiti gumi gumini* (Halmahera).

12. *Gnetum diminutum* MARKGRAF, Bull. Jard. Bot. Btzig III, 10 (1930) 483, t. 10, f. 9–13.

Climber. *Leaves* coriaceous, brown when dry, elliptic, shining, small, 15 cm long, 6 cm broad, secondary nerves bent, indistinctly joining, tertiary

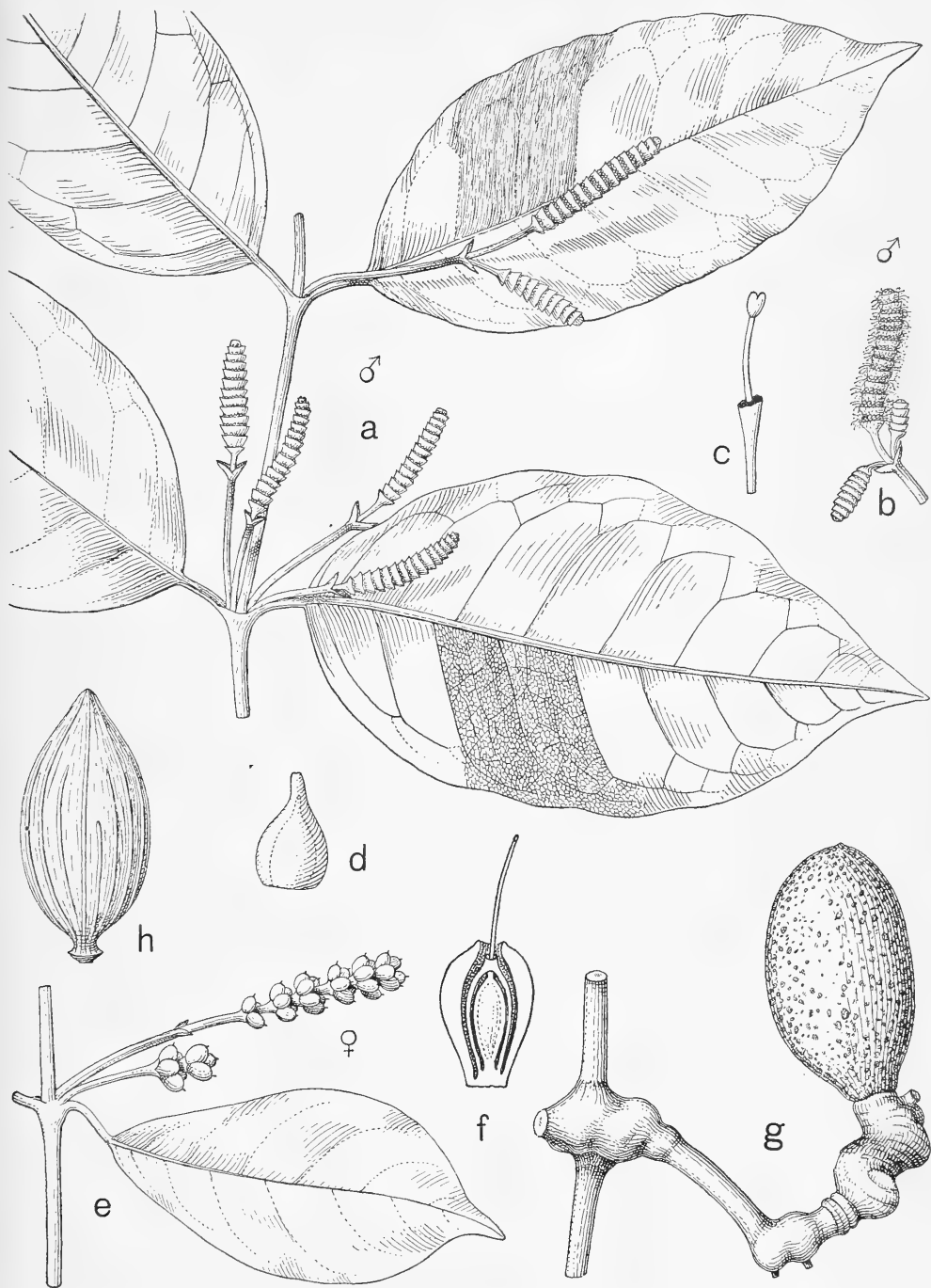


Fig. 5. *Gnetum gneumonoides* BRONGN. a-c ♂, d-h ♀ (a. twig, b. inflorescence, c. flower,  $\times 10$ , d. sterile ♀ flower,  $\times 10$ , e. inflorescence, f. section of flower,  $\times 4$ , g. infructescence, h. fruit without outer layer).

ones reticulate below. ♂ *Inflorescences* cauline, pendulous, short, spikes 3 cm long. ♂ Flowers numerous, obconic; sporophyll  $1\frac{1}{2}$  mm exserted. Sterile ♀ flowers 6 to each collar, ovate. ♀ *Inflorescences* simple, cauline, up to 10 cm long in the fruiting stage. ♀ Flowers 10 to each collar, immersed in a dense hair tuft, obliquely ovate. *Fruits* shining, ellipsoidal, small,  $1\frac{1}{2}$  cm long, 8 mm broad; outer envelop moderately fleshy, middle one slightly woody, inner one papery. Seed 1 cm long.

Distr. *Malaysia*: Borneo. Fig. 3.

Ecol. In rainforests especially on mountains, up to 1800 m.

Note. Closely allied to *G. cuspidatum*.

**13. *Gnetum macrostachyum* HOOK. f.** Fl. Brit. India 5 (1890) 642; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 484, t. 12, f. 1–7.—Fig. 11.

Climber. *Leaves* leathery, elliptic-oblong, 18 cm long, 8 cm broad, brown when dry, secondary nerves bent, distinctly joining, tertiary ones reticulate. ♂ *Inflorescences* simple, thick (7 mm), 5 cm long, axillary. ♂ Flowers obconic,  $1\frac{1}{2}$  mm long; sporophyll very shortly exserted, embedded in a dense hair tuft twice as long as the collars. Sterile ♀ flowers about 10 to each collar, ovate. ♀ *Inflorescences* cauline, simple, 9 cm long, 1 cm thick. ♀ Flowers 8–10 to each collar, embedded in a thick, long hair mass which is still more conspicuous than in the ♂ ones, globose, apiculate. *Fruits* shining, ellipsoidal, small, 2 cm long, 12 mm broad; outer envelop thinly fleshy, middle one leathery, inner one papery; hair masses twice as long and twice as large as in the flowering stage.

Distr. Tenasserim (Tavoy), Siam, and Indo-China to *Malaysia*: Sumatra, Malay Peninsula, Java, Borneo, and New Guinea.

Ecol. Apparently restricted and rare in the Archipelago, more frequent only in the Malay Peninsula.

**14. *Gnetum microcarpum* BL.** Rumphia 4 (1848) 7, t. 175, f. 1; MIQ. Fl. Ind. Bat. 2 (1856) 1068, Suppl. 1 (1860) 252; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 485.—*G. apiculatum* GRIFF. Not. Pl. As. 4 (1854) 31.—*G. neglectum* var. *microcarpum* PARL. in DC. Prod. 16, 2 (1868) 350.

Climber. *Leaves* fleshy, shining, greyish brown when dry, oblong or lanceolate, about 10 by 4 cm; secondary nerves indistinct, straight. ♂ *Inflorescences* cauline, erect, long-stalked,  $1\frac{1}{2}$  cm long,  $3\frac{1}{2}$  mm thick. ♂ Flowers numerous, obconic; sporophyll long-exserted. Sterile ♀ flowers many, ca 20–30 to each collar, fusiform. ♀ *Inflorescences* cauline, simple, erect; spikes  $2\frac{1}{2}$  cm long. ♀ Flowers 8 to each collar, ovate, 3 mm long. *Fruits* not shining, up to 2 cm long, ellipsoidal; outer envelop thinly fleshy, middle one leathery, inner one papery. Seed oblong, 1 by  $\frac{1}{2}$  cm.

Distr. Tenasserim (Mergui) to *W. Malaysia*: Malay Peninsula (also Langkawi), Sumatra and surrounding islands (Lingga, Riouw, Anambas, Banka). Fig. 4.

Ecol. The Malay Peninsular *f. campestris* (RIDL.)

MGF is said to occur in savannahs or open grounds, whereas the typical form inhabits rainforests.

Vern. *Manindjan hatan* (Lingga).

*f. microcarpum*.—*f. silvestre* (RIDL.) MGF, l.c. 486, t. 9 f. 2–8.—var. *silvestris* RIDL. J. Str. Br. R. As. Soc. 60 (1911) 62.

*Leaves* oblong-elliptic.

*f. campestre* (RIDL.) MGF l.c., t. 9, f. 1.—var. *campestris* RIDL. l.c.

*Leaves* lanceolate.

**15. *Gnetum oxycarpum* RIDL.** Kew Bull. (1926) 94; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 488, t. 9, f. 9–12.

Climber. *Leaves* fleshy, greyish brown when dry, elliptic, small, 12 cm long, 5 cm broad, secondary nerves straight, indistinct. ♂ *Inflorescences* cauline, short, erect, simple. ♂ Flowers clavate. Sterile ♀ ones ovate. ♀ *Inflorescences* similar. ♀ Flowers 8–10 to each collar, ovate, 4 mm long. *Fruits* yellow, not shining, oblong with a very acute apex,  $2\frac{1}{2}$  cm long, 8 mm broad; outer envelop thinly fleshy, middle one coriaceous, inner one papery.

Distr. *Malaysia*: Mentawai Islands (Siberut) near Sumatra. Fig. 4.

Note. Related to *G. microcarpum*.

**16. *G. leptostachyum* BL.** Rumphia 4 (1848) 5; PARL. in DC. Prod. 16, 2 (1868) 352; MARKGRAF, Bull. Jard. Bot. Btzg III, 10 (1930) 488.—Fig. 1f.

Stout climber. *Leaves* coriaceous, brown when dry, elliptic-oblong, up to 30 by 12 cm, often much smaller; secondary nerves bent, distinctly joining. ♂ *Inflorescences* often cauline, much branched, up to 33 cm long, catkins 3–6 cm long, 3–4 mm thick. ♂ Flowers 30–40 to each collar, immersed in a dense hair tuft, broadly obconic; sporophyll filiform, twice as long as the perianth. Sterile ♀ flowers 8–10 in each collar, broadly ovate. ♀ *Inflorescences* similar, their catkins 10 cm long. ♀ Flowers 6 to each collar, immersed in a dense hair tuft, globose, 3 mm thick. *Fruits* pink, shining, shortly ellipsoidal, obtuse, 2 cm long,  $1\frac{1}{2}$  cm thick; outer envelop thinly fleshy, middle one thinly woody, inner one papery. Seed 12 mm long, 8 mm thick.

Distr. *Malaysia*: Borneo, with a var. *elongatum* MGF in Indo-China and Siam. Fig. 3.

Ecol. Stout rainforest liana, preferring higher altitudes, up to 1500 m.

var. *leptostachyum*.—var. *tenuis* MGF, l.c. 489.

♂ Spikes narrow, 3–4 cm long, 3 mm broad. ♀ Spikes lax, internodes 8 mm long.

Distr. *Malaysia*: Borneo.

var. *robustum* MGF, l.c. 490.

♂ Spikes stout, 6 cm long, 4 mm broad. ♀ Spikes compact, their internodes 3 mm long.

Distr. *Malaysia*: Borneo.

Vern. *Baluhu* (Dusun), *paliat paliat* (Kedayan).

var. *abbreviatum* MGF, nov. var.

*Leaves* small (up to 12 by 6 cm), hard, distinctly

reticulate below. ♂ Inflorescences short (up to 6 cm), catkins 1½ cm by 3 mm. Internodes of fruiting ♀ ones very short (5 mm). Fruits large (2½ by 1½ cm).

Distr. *Malaysia*: Br. N. Borneo (Kinabalu).

Ecol. Stout liana of mossy, tall forest, 1300–1800 m.

Note. The varieties *leptostachyum* and *robustum* are without geographical significance. *Var. elongatum* MGF, however, and *var. abbreviatum* prefer higher altitudes, the more so, the nearer to the equator. Both combine floral characters of the lowland varieties in a different manner.

#### Doubtful

*Gnetum funicularis* BRONGN. in DUPERREY, Voy. Coquille (1829) 12.—*Gnemon funicularis* RUMPH. Herb. Amb. 5 (1747) 12, t. 8. RUMPHIUS's plate and description is insufficient for a proper identification.

*Gnetum indicum* (LOUR.) MERR. Interpr. Rumph. Herb. Amb. (1917) 77.—*Abutua indica* LOUR. Fl. Coch. (1790) 630.

Sheets from *Malaysia* distributed under this name belong to *G. latifolium* BL.; from other regions they either belong to *G. formosum* MGF or to *G. montanum* MGF. A real type of *Abutua*

*indica* does not exist, only uncertain leaves in the British Museum; the type locality is the home of more than one species. So the name remains doubtful.

*Gnetum karstenianum* WARB. Monsunia (1900) 196, 197, Moluccas (Batjan). The type consists of leaves only.

*Gnetum philippinense* WARB. l.c. Philippines (Luzon). The type consists of leaves only.

*Gnetum polystachyum* REINW. ex BL. Cat. Gew. Btzg (1823) 106, *nomen*. No type found.



# **THYMELAEACEAE—GONYSTYLOIDEAE** (H. K. Airy Shaw, Kew)

DOMKE, Bibl. Bot. 27, Heft 111 (1934) 30, 33, 103.

Trees, rarely shrubs. *Leaves* simple, mostly glandular-punctate, exstipulate. *Flowers* ♀, actinomorphic, 5-merous. *Calyx*-tube short, tube (and usually segments) densely setulose-hairy within. *Corolla* represented by 7–40 deltoid to linear-subulate processes, rarely by a low entire annulus. *Stamens* 8–80; filaments free, short, slender; anthers hippocrepiform. Disk 0. *Ovary* (2–)3–5(–8)-locular; cells with one anatropous ovule pendulous from the apex. Style elongate, filiform, sometimes accompanied by 'parastyles' at the base; stigma small, capitate. *Fruit* a thick-walled, woody, dehiscent, 1–5-seeded capsule, or a thin-walled, (?) indehiscent, 1–2-seeded capsule. *Seeds* large, without chalazal fold, usually with aril. Endosperm 0.

*Distr.* Almost confined to *Malaysia*, occurring in all parts of the archipelago except E. Java and the Lesser Sunda Isl.; found also in the Nicobar, Solomon and Fiji Islands. Genera 3. The greatest number of species is concentrated in Borneo, with apparently a marked inner centre of differentiation in the western part of the island. Fig. 1.

*Ecol.* Primary rain-forest at low and medium altitudes; one important species in freshwater swamp or peat forest.

*Uses.* Timber for planks, etc.; heartwood (*kayu garu*) for incense.

*Notes.* *Subfam. Gonystyloideae* differs from *subfam. Aquilarioideae* in: leaves usually pellucid-punctate; petals subulate to deltoid, often numerous, rarely represented by a low entire annulus; anthers hippocrepiform; disc absent; seeds without chalazal fold, usually with aril.

It differs from *subfam. Thymelaeoideae* in: leaves usually pellucid-punctate; calyx-tube very short or wanting; petals subulate to deltoid, often numerous, rarely represented by a low entire annulus; anthers hippocrepiform; disc absent; carpels 2–8; seeds usually without aril.

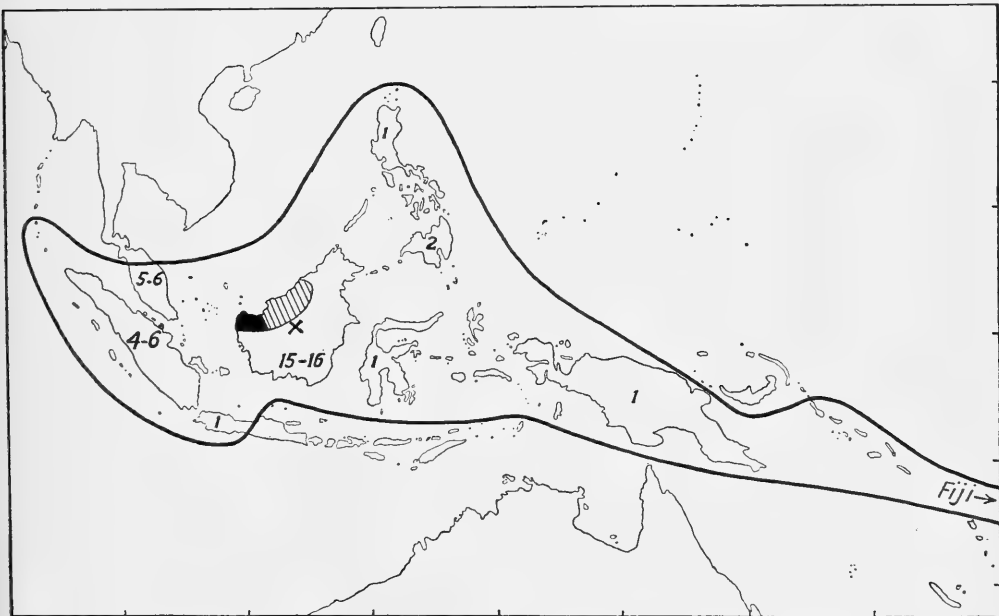


Fig. 1. Distribution of the *subfam. Gonystyloideae*. Continuous line: *Gonystylus* [and *G. macrophyllus* (Miq.) A.S.]. Black and hatched area: *Amyxa*. Black area: *Aëtioxylon* (and *Gonystylus* § *Auxanthus*). X: *Gonystylus areolatus* DOMKE ex A.S. Numerals indicate the number of species of *Gonystylus* known from the principal islands.

## KEY TO THE GENERA

1. Leaves (and branches) opposite or subopposite, coriaceous, smooth, with very lax, open, rather obscure venation. Inflorescence umbellate or almost so. Calyx-segments truly valvate. Corolla represented by a low, entire annulus. 'Parastyles' absent. Fruit irregularly subglobose or subpyriform, verruculose, apparently indehiscent . . . . . 3. *Aëtioxylon*
1. Leaves (and branches) perfectly alternate, chartaceous to coriaceous, nervation lax or more often close, very distinct, rarely obscure. Inflorescence variously thyrsoid, or rarely racemose, never umbellate. Calyx-segments imbricate, or only subvalvate. Corolla represented by 7–40 deltoid to filiform-subulate processes. 'Parastyles' sometimes present. Fruit various.
  2. Leaves rather thinly chartaceous, with very few main lateral nerves, the ultimate nervules almost invisible. Inflorescence a very slender, much-branched, many-flowered thyrs. Flowers small, sericeous outside. Petals 10, approximate in pairs. 'Parastyles' subulate-corniform. Fruit thin-walled, with a long cylindrical beak, apparently indehiscent . . . . . 2. *Amyxa*
  2. Leaves chartaceous to coriaceous, with numerous lateral nerves, these together with the ultimate nervules usually very conspicuous. Inflorescence irregular, not very slender, sometimes very robust, the flowers arranged in a nodose-fasciculate manner. Flowers usually much larger, usually tomentelous but rarely sericeous outside. Petals 7–40, not approximate in pairs. 'Parastyles', when present, very small and clavate. Fruit a thick-walled, woody, beakless, dehiscent capsule . . . 1. *Gonystylus*

## 1. GONYSTYLUS

TEYSMANN & BINNENDIJK, Bot. Zeit. 20 (1862) 265; DOMKE, Bibl. Bot. 27, Heft 111 (1934) 35, 103, 116, map 1; ERDTMAN, Svensk Bot. Tidskr. 40 (1946) 81; AIRY SHAW in HOOK. Ic. Pl. 35 (1947) t. 3474–3475; Kew Bull. 1950, 138–147. —*Asclerum* TIEGH. Ann. Sc. Nat. VII, 17 (1893) 245.—**Fig. 2–4.**

Mostly tall trees, occasionally shrubs. *Leaves* alternate, chartaceous to very coriaceous, commonly with sparse persistent hairs below, especially on midrib; young parts sericeous, tomentose, or velutinous. *Inflorescence* paniculate (i.e. basically racemose), the main branches few,  $\pm$  elongate, the lateral branches short, consisting of extremely condensed irregular nodulose racemes, often reduced to fascicles of flowers; or, in § *Auxanthus*, consisting of dense regular racemes of more or less unlimited growth. Bracts minute or, in § *Auxanthus*, small, falling very early. *Flowers* long-pedicelled. *Calyx*  $\pm$  cupular, divided to about 1/3 or 1/4; segments thick, tough, imbricate or subvalvate, slightly unequal (3 larger and 2 smaller),  $\pm$  tomentose without, always densely hispid-setulose within. *Corolla* represented by a ring of 7–40 deltoid or subulate, rigid, erect or incurved, glabrous or retrorse-hispid, sometimes pustulate processes (referred to in the descriptions below as 'petals'), often  $\pm$  shortly united below. *Stamens* about equal in number to the petals, rarely twice as many, inserted among the setulae at the base of the calyx; filaments very short and slender; anthers basifixed, broadly or narrowly oblong to obovate, doubled back over the top of the linear-tetragonal connective and decurrent down its back, 4-locular at first, later 2-locular by confluence of adjacent pairs of locelli. *Ovary* sessile,  $\pm$  globose, always densely hispid-setulose, (2–)3–4 (–5)-locular (rarely 6–8-locular); style elongate, filiform, wiry, sinuate-contorted, glabrous or pubescent, very occasionally accompanied at the base by 3–7 small clavate or subglobose 'parastyles'; stigma punctiform to capitate. Ovules solitary in each cell, pendulous from the apex, anatropous. *Fruit* a globose, or rarely (§ *Auxanthus*) lanceolate, woody, 2–5-valved, loculicidal (rarely indehiscent?) capsule, 1–5-seeded; mesocarp thick and fibrous, usually  $\pm$  verruculose; exocarp thinly fleshy. *Seeds* large, with smooth softly coriaceous testa, and thin dorsal aril arising from the fleshy funicle; cotyledons large, horny.

Distr. A genus of about 20 *spp.*, its area almost coinciding with that of the Malaysian region, outside this known only from the Nicobar, Solomon and Fiji Islands.

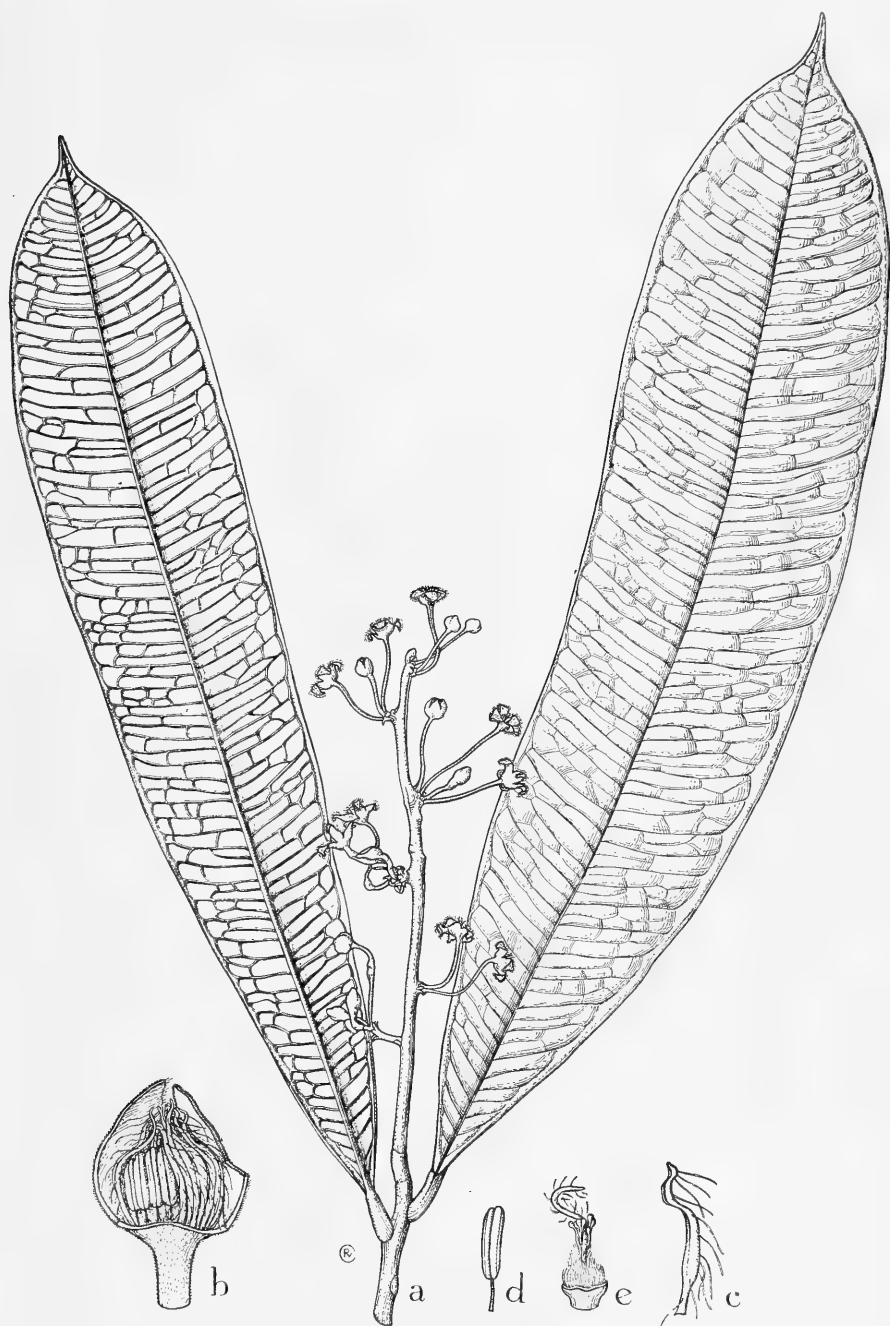


Fig. 2. *Gonystylus areolatus* DOMKE ex AIRY SHAW. *a.* Habit of flowering twig end,  $\times \frac{1}{3}$ , *b.* bud with part of calyx and some petals removed,  $\times 3$ , *c.* petal,  $\times 3$ , *d.* stamen,  $\times 3$ , *e.* ovary with style and 'parastyles',  $\times 2$  (all details from a mature bud). The buds and flowers in *a.* with thickened short pedicels or with swellings in the pedicels are galled and abnormal (after the type, JAHERI 773, from Dingai River,  $0^{\circ} 40' N$ ,  $114^{\circ} 25' E.$ ).



Ecol. Typically trees of the primary non-inundated rain-forest at low and medium elevations, reaching 1200 m in Sumatra and 1500 m in Borneo and the Philippines. *G. bancanus*, however, is a component of the (mainly coastal) freshwater swamps of the Malay Peninsula, Sumatra and Borneo, and it is possible that a second species occurs in this formation in Brunei; in such situations there is a development of pneumatophores. According to C. L. DURANT (For. Rep. Brunei 1933, p. 7) *G. bancanus (ramin)* is invariably associated with *Combretocarpus* and *Crypteronia*.

Wood anat. METCALFE & CHALK, Anat. Dicot. 2 (1950) 1178. DEN BERGER, Determinatietabel Houtsoorten van Malesië, Wageningen (1949), 47 (hand lens). JANSONIUS, Mikrograph. d. Holzes 5 (1934), 434, Blumea 6 (1950) 454.

Uses. The wood of most species seems relatively unimportant, but in recent years there has been considerable exploitation of that of *G. bancanus*—largely owing to this species sometimes occurring in pure stands—for internal building construction, planks, cases, etc.. Export of *ramin* is estimated to constitute one third of the total timber export of Sarawak (cf. Mal. For. 14, 1951, 167, 231, 233). The use as incense, by the natives of Sumatra, Java and Borneo, of the (?due to fungal action) resin-impregnated heartwood, or *kayu garu*, has been known since the time of RUMPHIUS.

Notes. The systematic position of *Gonystylus* has been somewhat disputed, BAILLON, GILG and others having proposed to constitute it a separate family near the *Tiliaceae*. Its position as a member of the *Thymelaeaceae* has, however, been well substantiated by DOMKE's work (1934, l.c. 1-3 *et passim*), and confirmed by ERDTMAN's (1946, l.c.) investigation of the morphology of the pollen and JANSONIUS's (1934 and 1950, l.c.) examination of the wood.

The characteristic colours assumed by the foliage of the different species on drying are noteworthy.

#### KEY TO THE SPECIES

1. Leaves very long, 40-50 cm, venation bullately impressed above, very prominent below. Inflorescence robust, with a very thick rhachis, up to 5 mm thick. Flowers large, with c. 40 petals and 80 stamens. Style robust, with large stigma, and 4-7 small clavate 'parastyles' near the base . . . . . 2. *G. areolatus*
1. Leaves shorter, 3-40 cm, venation not bullately impressed. Inflorescence much less robust. Flowers smaller, petals and stamens 10-40. Style slender; stigma small; 'parastyles' absent, but sometimes represented by 3-4 small rounded humps.
2. Inflorescence-branches elongating almost indefinitely, forming long crowded cicatricose racemes with a few flowers at the apex at the time of flowering. Leaves large, up to 29 × 14 cm. Petals 15-16, densely retrorse-setulose. Capsule lanceolate, 3- or 6-ribbed, apex as it were shortly and stoutly 3-winged (SECT. *Auxanthus* AIRY SHAW) . . . . . 1. *G. augescens*
2. Inflorescence-branches not elongating, bearing fascicles or short irregular racemes of flowers on short nodulose side-branches. Petals glabrous or occasionally setulose. Capsule ± globose, not or scarcely ribbed.
3. Leaves gradually narrowed at the apex into a relatively long slender acumen, cuneate at the base, up to 20 × 5 1/2 cm, almost glabrous, drying chestnut-brown. Inflorescence ferrugineous-tomentellous, branches shortly racemiform. Flowers truncate at the base . . . . . 11. *G. acuminatus*
3. Leaves not gradually narrowed into a long acumen, usually rather suddenly narrowed into a relatively short acumen or cusp, sometimes rounded or even retuse.
4. Pedicels 2-3 cm. Leaves usually large (up to 40 × 15 cm).
5. Inflorescence elongate, up to 20 cm long, branches relatively slender, often simple. Leaves drying ochraceous-brown; petiole relatively long and slender, up to 2 1/2 cm long . . . . . 5. *G. macrophyllus*<sup>1</sup>
5. Inflorescence short and stout, 7-12 cm long. Petiole short and stout, 9-13 × 2-4 mm.
6. Leaves cuneate at the base, drying light green with a narrow dark brown edge; nerves rather robust, dense, strongly reticulate. Calyx densely tomentellous. Petals about 40 . . . . . 4. *G. reticulatus*
6. Leaves rounded or subcordate at the base, drying a dark purplish-lead colour; nerves slender, relatively lax, less strongly reticulate. Calyx adpressed-puberulous. Petals 20-30. . . . . 3. *G. calophyllus*
4. Pedicels 1/2-2 cm; leaves small or medium.
7. Calyx-segments strongly reflexed or revolute at anthesis; petals 7-12. Inflorescence usually considerably branched. Flowers small. Leaves small, up to 13 × 5 cm, distinctly shagreened.
8. Petals tomentellous throughout and setulose within. Leaves elliptic or almost rhomboid, glabrous or almost so, usually ochraceous when dry; nerves rather steeply ascending 14. *G. forbesii*
8. Petals glabrous. Leaves elliptic to oblong but never subrhomboid, drying brownish or greenish; nerves rather widely spreading.
9. Young parts and inflorescence densely fulvo-velutinous. Leaves usually ± pubescent below, glossy above (even when dry), rather variable in shape, often cuneate at base . . . . . 15. *G. velutinus*
9. Young parts and inflorescence tomentellous. Leaves glabrous or almost so below, dull above when dry, regularly elliptic-oblong, mostly rounded at base . . . . . 16. *G. maingayi*

(1) Probably related to *G. macrophyllus*, but imperfectly known, is 6. *G. xylocarpus*. Leaves more rigidly coriaceous, rounded or very shortly subapiculate at apex. Fruits exceptionally massive and woody; pericarp almost stony.

7. Calyx-segments not or scarcely reflexed at anthesis.
10. Petals  $\pm$  10. Flowers very small (4–5 mm). Leaves drying a dull purplish-lead colour, up to 15  $\times$  6 cm . . . . . 18. *G. micranthus*
10. Petals 13–30. Flowers larger.
11. Leaves drying a dull purplish-lead colour; midrib flat or slightly raised above 12. *G. confusus*
11. Leaves not drying purplish-lead.
12. Petals retrorse-setulose within.
13. Petals 20–22. Leaves chartaceous, drying greyish-green above with a narrow brown border, pinkish-brown below; nervation lax, the primary nerves being distinctly differentiated from the secondaries . . . . . 9. *G. keithii*
13. Petals 25–30. Leaves coriaceous, drying chestnut-brown throughout; nervation rather dense. 10. *G. brunescens*
12. Petals glabrous.
14. Midrib distinctly prominent above. Sepals narrowly triangular-lanceolate. Leaves yellow-ochraceous when dry . . . . . 7. *G. stenosepalus*
14. Midrib flat or channelled above. Sepals ovate-deltoid.
15. Leaves small, 4–15 by 2–7 cm, coriaceous, often  $\pm$  conduplicate, drying dull purplish-red below and chestnut above; nervation relatively inconspicuous . . . . . 19. *G. bancanus*
15. Leaves various, but not conduplicate, nor drying as above; nervation more conspicuous.
16. Inflorescence densely fulvous-tomentellous. Leaves strongly shagreened, often persistently tomentellous below . . . . . 13. *G. affinis*
16. Inflorescence thinly adpressed-pubescent or subsericeous. Leaves not strongly shagreened, glabrous or shortly adpressed-pubescent below.
17. Leaves 12–24 by 4½–7½ cm . . . . . 8. *G. borneensis*
17. Leaves 9–11 by 3–4 cm . . . . . 17. *G. pendulus*

The colour of the leaves on drying being for many of the species very characteristic, the following synopsis may be found useful for herbarium specimens:

Dull purplish-lead: *calophyllus*, *confusus*, *micranthus*.

Green: *reticulatus* (both surfaces), *keithii* (grey-green, upper surface only, lower surface purplish-brown).

Dull purplish-red or purplish-brown below, chestnut above: *bancanus*.

Chestnut-brown throughout: *brunescens*, *acuminatus*.

Ochraceous-yellow or ochraceous-brown: *forbesii*, *macrophyllus* (variable), *stenosepalus*, *areolatus*.

Remainder indeterminate shades of brown, or colours not easily expressed in words.

**1. *Gonystylus augescens* RIDL.** Kew Bull. 1946, 43 (1946); AIRY SHAW, Kew Bull. 1947, 10 (1947); in Hook. Ic. Pl. 35 (1947) t. 3474; Kew Bull. 1950, 143–4, fig. 1 (1950).

Small tree; branchlets dark brown, glabrous. Leaves broadly elliptic or elliptic-oblong, 16–29 by 8–14 cm; base rounded to somewhat cordate, more rarely very broadly cuneate; apex rounded and shortly cuspidate-acuminate; margin often strongly reflexed, almost revolute at the base, firmly coriaceous,  $\pm$  chestnut-brown when dry, darker below, glabrous except for the sparsely puberulous midrib below, minutely shagreened on both surfaces; nerves very conspicuous, rather crowded, widely spreading; petiole robust, 10–15 by 3–4 mm, minutely puberulous. Inflorescences up to 18 cm long, 2–2½ mm thick, with 2–3 branches, densely ochraceous-tomentellous at first, later glabrescent; scars of the fallen flowers and bracts forming a dense, regular, nodulose spiral [somewhat resembling that seen in the Icacinaceae *Stemonurus corniculatus* BECC. (*Cantleya jehorica* RIDL.)], in 4 vertical rows, the successive members of each row being about 3–4(–8) mm apart. Bracts ovate-oblong, up to 7 by 2½ mm, cucullate, subsericeous, caducous. Pedicels 8–13 mm long, sericeous. Buds subglobose. Flowers (expanded) 7–9 mm diam. Sepals deltoid-ovate, 4–5 by 2–2½ mm, subobtusate, densely fulvo-sericeous. Petals c. 16, subulate, 3 mm, densely retrorse-setulose within, sparingly setulose or sub-

glabrous without. Style pubescent. Fruit (immature) broadly lanceolate, 5½ by 2¼ cm, 3-valved,  $\pm$  6-ribbed, the locular ribs broad, rounded or slightly angled, the sutural ones narrow, traversed by a fine groove, and forming a shortly 3-winged apex to the fruit, minutely rugulose, glabrous but covered with a fine brownish meal; calyx persistent, scarcely enlarged. Seed (very immature) compressed, narrowly elliptic, 2¼ by ¾ cm, solitary in the fruit examined.

Distr. *Malaysia*: Borneo (SW. Sarawak, NW. part of W. Indonesian Borneo).

Ecol. Unknown; probably rain-forest at low altitudes; fl. Oct.–Jan.

Notes. This interesting species is known only from the neighbourhood of Kuching, in Sarawak, and from the Singkawang-Benkayang-Mampawah area in the extreme NW. of Western Indonesian Borneo (*leg.* DE VRIESE, 1857–61). The curious inflorescences seem to have the power of almost unlimited growth; besides *Stemonurus corniculatus* quoted above, compare also *Knema tridactyla* AIRY SHAW [Kew Bull. 1939, 543–5 (1940)].

**2. *Gonystylus areolatus* DOMKE ex AIRY SHAW,** Kew Bull. 1952, 73 (1952).—Fig. 2.

Shrub? (or small tree?), branchlets robust, 5–10 mm thick, bark fuscous, apparently lax. Leaves very large for the genus, 40–50 by 7½–10¾ cm, oblong (more rarely oblanceolate-oblong), base rather long-attenuate,  $\pm$  rounded at the apex,

shortly deflexed-acuminate or cuspidate, chartaceous, shortly and sparsely pilose below, glabrous above, ochraceous-chestnut when dry (or greenish above); midrib robust, terete below, 3 mm thick, narrowly impressed above; nerves very conspicuous, bullately impressed above, sharply prominent below, widely spreading, in narrower leaves almost straight, in wider leaves arching forwards, conspicuously anastomosing 1–3 mm from the margin, laxly disposed (about 30 pairs of primary nerves in a leaf 40 cm long), 1–5 secondary or minor nerves between the primaries, all conspicuously connected by short transverse veinlets forming a beautifully areolate reticulation; petiole short, thick, 15–(30) by 5–(10) mm, rugose, almost glabrous. *Inflorescence* terminal, narrowly pyramidal-thyrsoïd, 10–21 cm long, fulvo-tomentellous; rhachis 3–5 mm thick; branches 1–2½ cm long, spreading or reflexed, many-flowered; pedicels up to 4 cm, straight, spreading, 1–2 mm thick at anthesis. *Calyx* (expanded) 1½–1¾ cm diam., very shortly adpressed-tomentellous outside; segments deltoid-lanceolate, subobtuse, 9–10 mm long, reflexed at anthesis, very densely setulose within. *Petals* ± 40, subulate, 6–7 mm, glabrous or retrorsely sparsely setulose, pustulate (pustules evident in bud, scarcely visible at anthesis). Stamens up to 80; filaments 1 mm; anthers 2 mm, narrowly oblong, caducous-setose. Ovary (?always) 6-locular; style robust, glabrous or setose, with, slightly above the base, 4–7 small, clavate, glabrous ‘parastyles’ 1–1½ mm; stigma rather large, cylindric-capitate. Fruit unknown.

Distr. *Malaysia*: Borneo (S. & E. Division).

Ecol. Unknown, but doubtless primary rain-forest.

Notes. A most distinct, ‘primitive-looking’ species, unlike any other. Not the least interesting feature is the development of the ‘parastyles’, which here give the impression of being actual abortive styles.

**3. *Gonystylus calophyllus* GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 372.**

Shrub or small tree; branchlets dark brown. *Leaves* elliptic to oblong, 16–30 by 6–10 cm, rounded to cordate at the base, shortly caudate-acuminate at the apex, chartaceous, glabrous, somewhat glossy, drying a purplish-lead colour; nervation conspicuous, rather close, widely spreading; midrib not deeply channelled above; petiole robust, 9–12 by 2–4 mm, finely ochraceous-puberulous. *Inflorescences* subsimple or 2–4-branched, with short, straight, thick, stiff, subfascicled branches, 4–12 cm long, rather thinly ochraceo-tomentellous. Pedicels elongate, 2½–2¾ cm, slender, adpressed-ochraceo-puberulous, rather gradually expanded into the calyx. *Calyx* 8–10 mm long, adpressed-puberulous; sepals lanceolate, 2½–3 mm wide, acute and subacuminate, erect or slightly spreading, the tips slightly recurved. *Petals* 20–30, subulate, 3–4 mm long, glabrous, epustulate. Ovary 3-locular, with three small pubescent subglobose

‘parastyles’; style pubescent below. Fruit unknown (‘green’ according to HAVILAND’s collector).

Distr. *Malaysia*: Borneo (SW. Sarawak).

Ecol. Unknown; probably lowland rain-forest; fl. Jan.–Feb..

Notes. Distinguished by the large leaves, drying a purplish-lead colour, and by the rather narrow, subacuminate sepals.

**4. *Gonystylus reticulatus* (ELM.) MERR. Philip. J.Sc. 12 (1917) Bot. 284; En. Philip. 3 (1923) 21.—*Thea reticulata* ELM. Leaf. Philip. Bot. 8 (1915) 2838.**

Small, slender tree, 12 m by 20 cm. Wood soft, light. Branchlets dark brown. *Leaves* oblong-oblancoate, base broadly cuneate, apex rounded and shortly cuspidate, 12–24 by 5–9½ cm, chartaceous-coriaceous, glabrous and somewhat glossy above, with sparse scattered ochraceous hairs below, midrib thinly adpressed pubescent, drying a relatively bright green on both surfaces, or sometimes ochraceous below, with a distinct narrow dark brown border; nervation very prominent, strongly reticulate, rather dense, midrib rather broadly and shallowly channelled above; petiole robust, 10–13 by 3–4 mm, pubescent below. *Inflorescences* relatively small, stout, 7–8 cm long, with 2–3 very short branches, densely ochraceous-pubescent when young, thinly so when mature. Pedicels c. 2½ cm, tomentellous. *Calyx* 12 mm long; sepals lanceolate, c. 10 by 4–5 mm, acute and subacuminate, densely tomentellous outside. *Petals* c. 40, filiform-subulate, c. 5 mm, glabrous, probably epustulate. Stamens c. 40. Style pubescent. Fruit (not seen in mature state) ‘irregularly globose’ (teste ELMER), up to 6 cm diam., 5-valved.

Distr. *Malaysia*: Philippines (Mindanao).

Ecol. Evergreen rain-forest at 900 m; fl. fr. Aug.

Notes. The important features of this species are the large flowers and the green colour of the leaves on drying, with a narrow brown margin.

**5. *Gonystylus macrophyllus* (MIQ.) AIRY SHAW, Kew Bull. 1947, 9 (1947); HILDEBRAND, Rep. For. Res. Inst. Indon. no 50 (1951) 90.—*Aquilaria? macrophylla* MIQ. Fl. Ind. Bat. Suppl. (1861) 356.—*Gonystylus miquelianus* TEYSM. & BINNEND. Bot. Zeit. 20 (1862) 265, *nom. illegit.*; MIQ. Ann. Mus. Bot. Lugd. Bat. 1 (1863–4) 133, t. 4; KURZ, Jour. As. Soc. Beng. 45, II (1876) 146; GRESHOFF, Nutt. Ind. Pl. (1897) 171–5, t. 40; BOERL. Handl. 3 (1900) 112; KOORD. & VAL. Bijdr. Booms. Java 9 (1903) 48; BOORSMA, Bull. Dép. Agric. Ind. Néerl. no 7 (1907) 6.—? *G. philippinensis* ELM. Leaf. Philip. Bot. 7 (1915) 2674.—*G. obovatus* MERR. Philip. J.Sc. 12 (1917) Bot. 283.—*G. bancanus* [non (MIQ.) KURZ] PERK., Fragm. Fl. Philip. (1904) 79; KOORD. Exk. Fl. Java 2 (1912) 572; Atl. Baumart. Java 2 (1914) t. 300; MERR. En. Philip. 3 (1923) 21; METCALFE in Kew Bull. 1933, 10, t. II (anat.) (1933); *et auct. al., quoad pl. Jav., Sum. et Philip.***

Tree, up to 45 by 1 m. *Leaves* exceedingly variable in size and shape, oblong, elliptic, obovate or sublancoate, 3–40 by 2–15 cm, base cuneate to rounded, apex acuminate to rounded or even

retuse, chartaceous to coriaceous, drying various shades of ochraceous-brown, slightly (rarely strongly) shagreened above, scarcely so beneath, glabrous; nervation (especially on lower surface) characteristic, consisting of a rather open network of prominent relatively steeply ascending nerves, of uniform thickness, connected by rather frequent short cross-veins of similar thickness, producing a system of irregularly elongate areolae; midrib deeply channelled above; petiole relatively long, up to  $2\frac{1}{2}$  cm. *Inflorescence* often almost simple, consisting of an elongate axis up to 20 cm with sessile nodulose fascicles of flowers 1–2 cm apart, but sometimes branched, ochraceous-tomentellous when young, cinereous later. Pedicels elongate, slender, up to  $2\frac{1}{2}$  cm. *Calyx* shortly cupular, 6–8 mm long, 10–15 mm diam., sericeous; sepals ovate-deltoid, acute or obtuse, margin often reflexed. *Petals* 20–40, narrowly subulate, glabrous, epustulate (? sometimes minutely pustulate), 2–3 mm. Style glabrous. *Fruit* large, globose, up to 7 cm diam., 3–5-valved. Seeds semi-ellipsoid, 4 by  $2\frac{1}{2}$  cm.

Distr. Nicobar Isl. (Kamorta), *teste* KURZ, .c.; in *Malaysia*: widespread, but not recorded from Central & E. Java and the Lesser Sunda Islands.

Ecol. Primary forests at low and medium altitudes, ascending to 1200 m in Sumatra and to 1500 m in the Philippines; *fl.* Sept., Dec.–April; *fr.* May–June.

Uses. Wood for small boxes; heartwood for incense.

Vern. *Kělēmbak*, Johore, *garu*, *pinang bai* (*bai*, *baik*), *médang ramuān*, *sirantih kunji*, *batu radja*, Sumatra, *puchatutup*, Mentawai, *garu kapas*, *garu hidung*, *sēndarēn*, *bēngang*, *kī laba*, W. Java, *garu tjampaka*, *garu bēlul*, *médang karan*, W. Borneo, *anauan*, *asuaa*, *busilak*, *lanutan-bagio*, *pamalaan*, *panakuraring*, *pandit*, *sambulauan*, Philippines, *nio*, Talaud, *udim abiri* (? *akiri*), Morotai, bunta, Ceram, *ruwala*, *mangērai*, Aru.

Notes. A very variable and widespread species, characterized principally by the venation and long pedicels. *G. philippinensis* ELM. was based upon an exceptionally small-leaved form, superficially resembling *G. bancanus*, but there is little doubt that it belongs here. The Babuyan Islands, type locality of *G. obovatus* MERR., represent the northernmost limit of the genus. The imperfectly known *G. megacarpus* C. T. WHITE (Solomon Isl.) and *G. punctatus* A. C. SMITH (Fiji) may well prove ultimately to be referable to *G. macrophyllus*.

**6. *Gonystylus xylocarpus* AIRY SHAW, Kew Bull. 1952, 73 (1952).**

Tree, 12 by 1.2 m. *Leaves* broadly elliptic, 10–17 by  $4\frac{1}{2}$ –9 cm, rounded at base and apex, or apex sometimes very shortly subapiculate, margin reflexed, rigidly coriaceous, brownish when dry, somewhat shining above, glabrous except for the midrib sparsely puberulous below; midrib narrowly incised above, robust below; nerves rather closely reticulate above, laxer below, anastomosing into a distinct intra-marginal nerve. *Inflorescence*

robust, up to 12 cm long; rhachis somewhat flattened, 3–4 mm thick; branches thick, very short, up to 8 mm long, apparently many-flowered at the apex, very minutely ferrugineo-puberulous. *Flowers* unknown. *Fruit* globose, indehiscent (?), up to  $7\frac{1}{2}$  cm diam., pericarp  $1\frac{1}{2}$ –2 cm thick, very woody or almost stony, externally verruculose, pedicel 20 by 7 mm. *Seeds* complanate-ovoid, up to  $3\frac{1}{2}$  by 2 cm; testa smooth, somewhat shining, deep brown, scarcely 1 mm thick.

Distr. *Malaysia*: W. Borneo (SW. Sarawak and adjacent Indonesian Borneo).

Ecol. Probably rain-forest at low altitudes; *fr.* Feb.–Apr.

Uses. Timber for cheap furniture (Sarawak).

Vern. *Ramin*, Sarawak, *médang bēlēt*, Indonesian Borneo.

Note. The status of this species is uncertain; it may prove to be an extreme form of *G. macrophyllus* (Miq.) A.S. when the flower becomes known. The exceptionally coriaceous leaves and massive fruits appear, however, to be distinctive.

**7. *Gonystylus stenosepalus* AIRY SHAW, Kew Bull. 1947, 9 (1947), in *adnot.***

Small tree. Branchlets ochraceous brown. *Leaves* elliptic, 12–20 by 5–9 cm, rounded at base, shortly acuminate at apex, chartaceo-coriaceous, glabrous, yellowish-ochraceous when dry, smooth but not shining on both surfaces, not shagreened; venation distinct on both surfaces, moderately close; midrib narrowly prominent above; petiole 12 by 1–2 mm, conspicuously channelled above, glabrous. *Inflorescences* simple, terminal, 12–14 cm long, with very shortly peduncled fascicles of flowers, thinly adpressed-puberulous. Pedicels elongate, slender,  $1\frac{1}{2}$ –2 cm, shortly sericeous. *Flowers* 6–7 mm long. *Sepals* narrowly triangular, c. 5 mm long, 2– $2\frac{1}{2}$  mm wide at the base, acute, shortly sericeous. *Petals* about 20, subulate, 4 mm, pustulate, glabrous. Style glabrous. *Fruit* unknown.

Distr. *Malaysia*: Borneo (Sarawak).

Ecol. Unknown, but doubtless primary rain-forest.

Notes. Distinguished from all other species by the midrib being prominent above, and by the narrow sepals. The yellowish colour of the leaves on drying, and the pustulate but glabrous petals, are characters shared with *G. macrophyllus*.

**8. *Gonystylus borneensis* (TIEGH.) GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; BOERL. Handl. 3 (1901) 112; MERR. En. Born. (1921) 372; DOMKE, Bibl. Bot. 27, Heft 111 (1934) t. I, fig. 2a–b.—*Asclerum borneense* TIEGH. Ann. Sc. Nat. VII, Bot., 17 (1893) 247.—*G. bancanus* [non (Miq.) KURZ] MERR. Pl. Elm. Born. (1929) 184, *quoad* ELMER 21768 *tantum*.**

Shrub or tree, trunk up to 60 cm diam.. Twigs blackish. *Leaves* elliptic to oblong, sometimes slightly oblanceolate or panduriform, 12–24 by  $4\frac{1}{2}$ – $7\frac{1}{2}$  cm, base  $\pm$  cuneate, rarely almost rounded, apex shortly cuspidate-acuminate, rather thinly chartaceous, dull pale brownish when dry, glabrous except for the sometimes thinly puberulous

midrib below; nervation very fine, dense and parallel; midrib shallowly channelled above or almost flat; petiole 8–12 by 2 mm, puberulous. *Inflorescences* 10–20 cm long (only 1–5 cm in the type, but doubtless not properly developed), subsimple, thinly adpressed-pubescent. Pedicels 1–1½ cm, densely fulvo-velutinous. *Calyx* 7–8 mm long, velutinous; sepals 5–6 mm long, ovate-lanceolate, subacute. *Petals* 25–30, subulate, glabrous, epustulate. Style glabrous. *Fruit* up to 7 cm diam..

Distr. *Malaysia*: Borneo.

Ecol. Rain-forest, prob. at low altitudes; *fl.* May, *fr.* Oct.–March. According to a MS. note by BECCARI (*in herb. Becc.*), the flowers open for a very short time only and are difficult to find in this state.

Notes. A species of doubtful status, known at present only from two flowering collections from Mt Matang in SW. Sarawak, and a fruiting collection from near Sandakan in Br. N. Borneo. The fine, close, parallel venation of the rather thin leaves is the most obvious feature; in this and in its glabrous petals it differs from *G. keithii*, which it otherwise somewhat resembles.

**9. *Gonystylus keithii* AIRY SHAW**, Kew Bull. 1947, 13 (1947).—*G. bancanus* [non (MIQ.) KURZ] MERR. Pl. Elm. Born. (1929) 184, *quoad* ELMER 21480.

Shrub or tree, 4½–26 m by 15–90 cm. Bark of twigs blackish-grey. *Leaves* elliptic-oblong to oblanceolate, 13–24 by 4–9 cm, base broadly cuneate or almost rounded, apex abruptly and shortly cuspidate-acuminate, chartaceous, usually drying conspicuously discolorous, greyish-green above (with a very narrow purplish-brown margin) and pinkish-brown below, practically glabrous throughout; nervation comparatively lax, primary nerves 12–15 pairs, widely patulous, distinctly differentiated from the secondary nerves; petiole 1–1½ cm, rather slender, minutely puberulous or glabrescent. *Inflorescences* mostly terminal, rather simple, 9–12½ cm long, sparsely puberulous, the short branchlets densely grey-subsericeous. Pedicels slender, up to 2 cm, densely ochraceous-tomentellous. *Sepals* ovate or oblong-ovate, c. 8 by 3–5 mm, densely subsericeous within and without. *Petals* 20–22, filiform-subulate, c. 5 mm, often uncinately-recurved at the apex, conspicuously white-pustulate within towards the apex, each pustule bearing a short retrorse seta. Style glabrous. *Fruit* (when mature) at least 6½ cm long, rugose. Seed 4 by 2¾ cm, smooth, chestnut coloured; calyx persistent, scarcely enlarged.

Distr. *Malaysia*: Borneo.

Ecol. Evergreen non-inundated rain-forest, up to 410 m, mostly on sandy soil; *fl.* March–June and Oct.

Uses. As fish poison (pounded fruit mixed with ash) and as medicine (unspecified), in Br. North Borneo.

Vern. *Mangriau* (? *mangsián*), *saukau*, *malindah*, *karai*, *kayu arang*, Br. N. Borneo, *sampah songkop*, *bépisang*, W. Borneo, *létung*, E. Borneo.

Notes. The colour of the leaves on drying is

very characteristic of this species, as also is the relatively lax venation. The material seen from Indonesian Borneo is all sterile, and is referred here on the basis of these characters alone.

**10. *Gonystylus brunnescens* AIRY SHAW**, Kew Bull. 1950, 138 (1950).—*G. bancanus* [non (MIQ.) KURZ] HEINE, in FEDDE, Rep. 54 (1951) 239.

Tree 18–23 m high, with habit of *Polyalthia* or *Garcinia*, branchlets dark brown. *Leaves* elliptic to oblong, 12–26 by 4–10 cm, cuneate to rounded at the base, ± rounded or subacute at apex, shortly deflexed-cuspidate, margin conspicuously reflexed, rather firmly coriaceous, glabrous, mostly chestnut-brown on both sides when dry, somewhat shagreened above, but not below; lateral nerves rather numerous, close and conspicuous; petiole 12–15 by 1–3 mm, minutely puberulous when young. *Inflorescences* terminal, sub-simple, 4–11 cm long, finely adpressed-pubescent or ferrugineous-tomentellous. Pedicels 5–12 mm, densely pubescent. *Flowers* c. 7 mm in diameter, ochraceo-sericeous. *Calyx* truncate and gibbous at base; sepals ovate-deltoid, 4–5 by 3 mm, subobtusate. *Petals* 25–30, subulate-filiform, c. 3 mm, glabrous outside, rather densely retrorse-hispid within, epustulate, variously connate below. Style glabrous. *Fruit* (probably immature) ovoid, 3½–4 cm diam., trilocular; pedicel 3–3½ cm; persistent calyx-segments up to 7 mm long.

Distr. *Malaysia*: Malay Peninsula (E. Coast), Borneo.

Ecol. Evergreen non-inundated rain-forest at 175–345 m [but reaching 1500 m on Kemul (Kongkemul) in E. Borneo and on Mt Kinabalu], mostly on clay or sandy clay soil; *fl.* Oct.–Nov.; *young fr.* Oct..

Vern. *Mahabai binjak*, *lemiar*, *gërima*, *garu tjampaka* (and perhaps *seriangun*, *médang kèlik*), W. Borneo, *kelat*, Brunei, *paliu*, *nasi-nasi*, N. Borneo.

Notes. The leaves usually drying chestnut-brown on both sides and the setulose petals are characteristic of this species. Sometimes the leaves dry a dull greenish-brown above, but the channelled midrib remains yellowish, producing a characteristic effect.

**11. *Gonystylus acuminatus* AIRY SHAW**, Kew Bull. 1952, 74 (1952).

Tree, 25 by ½ m. *Leaves* oblong or lanceolate-oblong, 12–20 by 3–5½ cm, cuneate at the base, gradually narrowed at the apex into a 1–1½ cm long acumen, thinly chartaceous, chestnut-brown when dry, glabrous (except occasionally here and there along the midrib below); midrib narrowly impressed above, nerves slender, widely patulous, rather dense, not very conspicuous; petiole 9–12 by 1–2 mm, sparsely puberulous. *Inflorescences* 8–13 cm long, slender, subferrugineo-tomentellous, with several branchlets, these racemiform, relatively elongate, ½–3 cm long; flowers scattered, not nodose-fasciculate; pedicels 1¼–1½ cm, densely tomentellous. *Calyx* shortly cupuliform, distinctly gibbous-truncate at the base, c. 4 mm long, 6–7 mm

wide, tomentellous; segments ovate-deltoid, obtuse, strongly revolute at anthesis. *Petals* 20–25, subulate, 2 mm, glabrous, epustulate. Style glabrous. Fruit unknown.

Distr. *Malaysia*: Borneo (S. & E. Division), ?Malay Peninsula, ?Sumatra.

Ecol. Primary rain-forest at 150 m; *fl.* Nov.

Notes. Probably referable here is a sterile specimen from Kokmoi Forest Reserve, Kedah (Malay Peninsula), and less probably one from Lampong Distr. (S. Sumatra).

**12. *Gonystylus confusus*** AIRY SHAW, Kew Bull. 1947, 10 (1947).—*G. maingayi* auctt., *p.p.*, non Hook. f..

Tree, 15–30 m by 60 cm, sometimes with pendulous branches, bark of branchlets dark brown. *Leaves* oblanceolate-oblong or rarely oblong, 9–27 by  $3\frac{1}{2}$ –9 cm, cuneate to rounded at the base, cuspidate to shortly acuminate at apex, chartaceo-coriaceous, glabrous except for a few adpressed hairs near the midrib below, glossy in the fresh state, drying a dull purplish-brown or leaden colour (the lower side more brownish); venation slender, parallel, prominent; midrib flat or very slightly raised above, not channelled; petiole 8–17 by 1–3 mm, glabrous. *Inflorescences* terminal, occasionally apparently axillary, 6–20 cm long, simple or with up to 4 branches, these up to 13 cm, adpressed-pubescent. Pedicels up to 18 mm, densely fulvo-tomentellous. Buds globose, 5 mm diam. before anthesis. *Sepals* ovate-deltoid, 6–7 by  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm, ochraceo-tomentellous, subacute to subobtuse. *Petals* c. 30, subulate-filiform, 3–4 mm, glabrous, epustulate. Ovary c. 3 mm long, with 3 small subglobose pubescent 'parastyles' round the base of the style; style glabrous. *Fruit* subglobose, 4–10 cm diam.; pericarp 7–8 mm thick. Seeds up to  $3\frac{1}{2}$  cm diam..

Distr. *Malaysia*: Malay Peninsula, ?N. Sumatra (E. Atjeh).

Ecol. Evergreen non-inundated rain-forest, 90–360 m; *fl.* March–Apr. and Sept.–Nov., *fr.* May–Aug. and Dec.–Febr..

Uses. Decoction of roots given after childbirth (Pahang); *cf.* BURKILL & HANIFF, Gard. Bull. S.S. 6 (1930) 179.

Vern. *Karu-karu*, Selangor, *pinang muda*, Perak, *gëlugor tawar*, Pahang, *banitan*, *sitabai*, Sumatra.

Notes. The colour of the leaves on drying, combined with the flat or slightly raised midrib on the upper surface, distinguishes this species from all others.

**13. *Gonystylus affinis*** RADLK. Sitzb. Math.-Phys. Kl. Bayer. Akad. Wiss. 1886, 16 (1887) 329; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 371.—*G. beccarianus* TIEGH. Ann. Sc. Nat. VII, Bot. 17 (1893) 245, *descr. anat. tantum*.

Tree, 9–24 m. Branchlets blackish. *Leaves* elliptic to almost oblong, 10–17 by  $3\frac{1}{2}$ – $8\frac{1}{2}$  cm, broadly cuneate to rounded at base, shortly caudate-acuminate at apex, margin markedly revolute, chartaceous, drying various shades of dull brown

or greenish-brown, strongly shagreened especially above, glabrous above, often rather persistently tomentellous below, especially on midrib; nervation relatively lax and not very conspicuous, patulous to widely spreading; petiole 1– $1\frac{1}{2}$ –(2) cm by  $2\frac{1}{2}$  mm. *Inflorescences* terminal, 8–12 cm long, of 1–3 main branches, each with several short side-branches, densely fulvous-tomentellous. Pedicels 8–14 mm, tomentellous. *Calyx* 5 mm long; sepals 3 mm long, deltoid-ovate, obtuse or subobtuse. *Petals*  $\pm$  20, filiform-subulate, 4–5 mm. Style glabrous. *Fruit* (?immature) up to  $4\frac{1}{2}$  cm long, 3–4-valved.

Distr. *Malaysia*: Malay Peninsula, Borneo (SW. Sarawak, ?W. Indonesian Borneo).

Ecol. Open rain-forest, 40–240 m; *fl.* April and Oct., *fr.* July, Oct., Dec..

Uses. Wood (reddish, floats in water) used for house-construction in Negri Sembilan (Mal. Pen.).

Vern. *Pokó batu pasir*, Negri Sembilan, *banit*, W. Indonesian Borneo.

Notes. Characterized by the brownish colour of the leaves on drying, their strongly shagreened surface, the tomentellous midrib below, the strongly tomentellous inflorescence, and the small flowers resembling those of *G. forbesii* and *G. maingayi* but with less reflexed sepals and twice as many petals.

**14. *Gonystylus forbesii*** GILG in ENGL. & PR. Nat. Pfl. Fam. Nachtr. 1 (1897) 232; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 372; S. MOORE, J. Bot. 62, Suppl. (1924) 14; *ibid.* 63, Suppl. (1925) 90.—*G. warburgianus* GILG ex DOMKE, Bibl. Bot. 27, Heft 111 (1932) 5, 8, 33, 146, t. 4, f. 32.—*G. bancanus* [non (MIQ.) KURZ] S. MOORE, *ll.cc.*

Tree 20–40 m by 35–85 cm. Branchlets blackish. *Leaves* elliptic, often almost rhomboid, 4–10 (– $11\frac{1}{2}$ ) by  $2\frac{1}{2}$ –5 cm, base usually markedly cuneate, occasionally slightly rounded, apex mostly cuneate-acuminate or sometimes  $\pm$  rounded and caudate, rather thinly chartaceous, shagreened on both surfaces, drying usually light ochraceous-brown, glabrous throughout or thinly puberulous below, especially on midrib; nerves slender, crowded, conspicuous below, much less so above, rather more steeply ascending than most *spp.* (*cf.* also *G. pendulus*), midrib narrowly channelled above, or rarely almost flat; petiole slender, 9–11 mm long. *Inflorescence* 5–15 cm long, considerably branched, shortly cinereo-ochraceo-tomentellous. Pedicels slender, 10–11 mm, tomentellous. *Calyx* shortly cupular, 4–6 mm long, 6–7 mm diam., tomentellous; sepals ovate-deltoid, 3–5 by 2–3 mm, subobtuse. *Petals*  $\pm$  10, ovate-deltoid, acuminate, 1–2 mm long, tomentellous throughout and densely retrorse-setulose within. Style glabrous. *Fruit* oblong-ellipsoid, 4 cm long, 3-valved.

Distr. *Malaysia*: Sumatra (incl. Mentawai Isl.), S. Borneo.

Ecol. Frequent in evergreen non-inundated rain-forest, on sand or clay, as scattered individuals or small groups, from sea level to 1210 m; *fl.* Sept.–Nov., *fr.* Nov. & June.

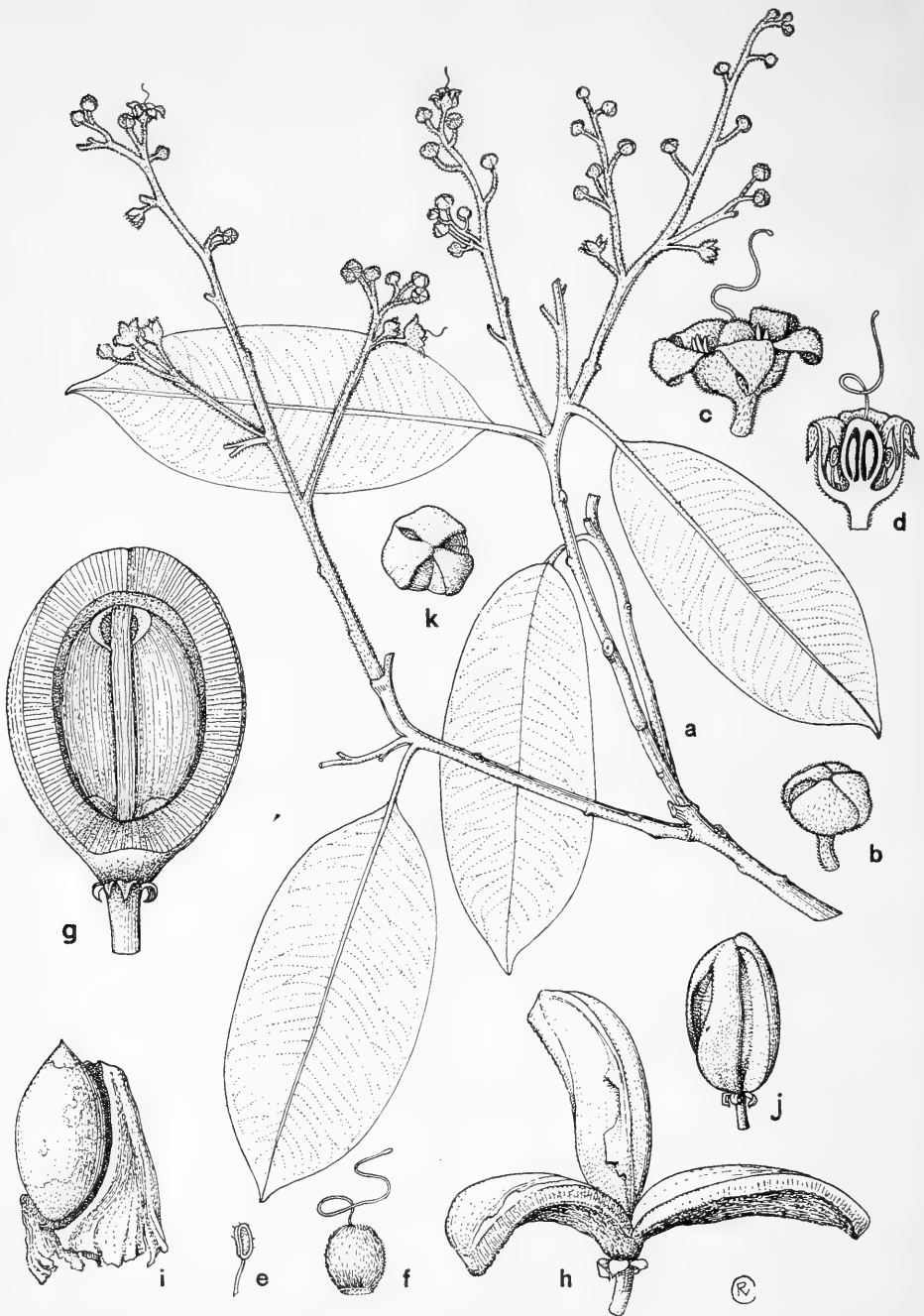


Fig. 3. *Gonystylus velutinus* AIRY SHAW. *a.* Flowering twig,  $\times 3/4$ , *b.* bud,  $\times 4$ , *c.* flower,  $\times 4$ , *d.* ditto, in section,  $\times 4$ , *e.* stamen,  $\times 7$ , *f.* gynoecium,  $\times 4$ , *g.* fruit, pericarp partly removed,  $\times 3/4$ , *h.* dry, dehiscent fruit,  $\times 3/4$ , *i.* placental tissue with seed, testa with remains of membranous aril,  $\times 3/4$ , *j.* abnormal juvenile 2-valved, 1 seeded fruit,  $\times 3/4$ , *k.* juvenile 3-valved, 1-seeded fruit from top,  $\times 3/4$  (*g.* from 15 T 1 P 17, *h-i* from 15 T 3 P 812, others from 15 T 1 P 21).



Vern. *Maranti tanduk*, *banitan nirang*, *médang*, *djao-djao*, *kayu pisang*, *méranti kambung*, ? *kélat*, *tapih*, Sumatra, *sibutoh bulug*, *salio bulug*, *puchatutut*, Siberut, *paoh balang*, *bakubal*, *bérmiang*, *sérkaja*, *koöp*, *mérang*, *dédarah putih*, Borneo.

Notes. A rather well-marked species, owing to its small, elliptic, often almost rhomboid leaves, strongly cuneate at base and acuminate at apex, with relatively steeply ascending parallel veins and shagreened surface; and the small flowers with c. 10 petals, which are both tomentellous and setulose.

**15. *Gonystylus velutinus*** AIRY SHAW, Kew Bull. 1950, 140 (1950).—*G. bancanus* [non (MIQ.) KURZ] HALLIER f. Med. Rijks herb. no 44 (1922) 14–15, *quoad specim. Expos. Paris no 17 et VAN ROSSUM no 33 tantum*.—Fig. 3.

Tree, 23–35 m by 40–70 cm. Branchlets dark brown, densely fulvo-velutinous when young, ultimately  $\pm$  glabrescent. *Leaves* elliptic, oblong-elliptic or lanceolate-elliptic, 8–11(–13) by  $3\frac{1}{2}$ –5 cm, base cuneate to subrotundate, apex shortly and narrowly cuspidate-acuminate, glabrous, evidently shagreened and distinctly glossy above, usually more or less pubescent below, but sometimes only minutely so, densely fulvo-velutinous in the young state, chartaceo-coriaceous, obscurely brown or ochraceous when dry; nerves very slender, crowded, parallel,  $\pm$  prominent on both surfaces; petiole 7–11 by 1–2 mm, densely velutinous. *Inflorescences* terminal and axillary, 7–12 cm long, densely fulvo-tomentellous, sparsely branched. *Flowers* small, c.  $\frac{1}{2}$  cm diam. when expanded; pedicels 8–10 mm, tomentellous. *Calyx*-tube depressed-globose, 3 mm diam., rugulose; segments deltoid, c. 3 mm long, acute, strongly revolute at anthesis. *Petals* 7–8, deltoid, acute, 2 mm long, incurved. Style glabrous. *Capsule* lanceolate-oblong,  $3\frac{1}{2}$ – $5\frac{1}{2}$  cm long, very woody; valves 3 (rarely 2),  $1\frac{1}{4}$ – $2\frac{1}{2}$  cm wide,  $\frac{1}{2}$  cm thick. Seeds  $2\frac{1}{2}$ –3 cm long.

Distr. *Malaysia*: Sumatra, Banka, Billiton; probably also Borneo.

Ecol. Locally rather common, as isolated trees, in primary rain-forest at very low altitudes, mostly on non-inundated sandy soil, but also noted on clayey swampy ground by creeks, etc., subject to annual inundation; fl. Aug.–Oct., fr. Dec.–Jan..

Uses. Timber for planks and house construction in Sarawak, if this species. Sap said to be irritant.

Vern. *Kayu minyak*, *ulu tupai*, *bitis*, Sumatra, *durin bēlan*, *mēnamang*, Banka, *malam*, Billiton; also *lēmpong*, *tēbakau puteh*, *bēsilih*, *babingkal*, *ramin*, Borneo, if this species.

Notes. Distinguished from *G. maingayi*, of which it might be regarded as a race, by the strongly velutinous indumentum of the young parts, and especially of the inflorescence.

**16. *Gonystylus maingayi*** HOOK. f. Fl. Br. Ind. 5 (1886) 200; GRESHOFF, Nutt. Ind. Pl. (1897) 171, *in obs.*; RIDL. J. R. As. Soc. Str. Br. no 35 (1901) 85, p.p.; J. As. Soc. Beng. 75 (1912) 266, p.p.; Fl.

Mal. Pen. 1 (1923) 322, p.p.; AIRY SHAW, Kew Bull. 1947, 12 (1947), p.p., *quoad specim. e Malacca, Negri Sembilan et Singapore tantum*.

Tree, up to 27 m. Branchlets blackish, thinly ochraceo-puberulous when young, soon glabrescent. *Leaves* small, very regular in shape and size, elliptic-oblong, 7–12 by  $2\frac{1}{2}$ – $4\frac{1}{4}$  cm (up to 17 by 6 cm in Sumatra), cuneate to rounded at base, narrowed and acuminate at apex (rarely more abruptly cuspidate), chartaceous, strongly shagreened especially above (Sumatran form much less so), glabrous (finely puberulous below when young), midrib thinly puberulous below; nervation close and reticulate, rather widely spreading, conspicuous below, midrib rather deeply channelled above; petiole relatively long and slender, 8–15 by 1–2 mm, ochraceo-tomentellous when young, puberulous later. *Inflorescences* terminal, up to 14 cm long, rather copiously produced, with numerous short branches, densely tomentellous. Pedicels slender, 8–10 mm. *Calyx* 4–5 mm long, 5–7 mm diam., densely tomentellous; sepals deltoid, 2–3 mm long, apex subacute to subobtusate, revolute at anthesis. *Petals* 10–12, triangular-subulate to ovate-acuminate, 2– $2\frac{1}{2}$  by up to 1 mm, glabrous, epustulate. Style glabrous. *Fruit* 3–4 cm long.

Distr. *Malaysia*: Malay Peninsula, Sumatra (Palemang).

Ecol. Primary rain-forest up to 150 m; fl. Oct.–Nov., fr. Apr..

Vern. *Mērawan pēnak*, Negri Sembilan, *sēpa petri*, Malacca, *bēmban-itam*, Sumatra.

Notes. Differs from *G. forbesii* in the shape, and from *G. velutinus* in the scanty or absent pubescence, of the leaves. Leaves very similar to *G. pendulus* in size and shape, but lateral nerves of *maingayi* more widely spreading and flowers quite different. The Sumatran form differs somewhat from that of the Malay Peninsula, the leaves being much less strongly shagreened.

**17. *Gonystylus pendulus*** AIRY SHAW, Kew Bull. 1950, 141 (1950).

Small tree,  $10\frac{1}{2}$  m by  $12\frac{1}{2}$  cm, with elongate pendulous branches, bark of twigs dark brown. *Leaves* small, oblong-elliptic or almost oblong, 9–11 by 3–4 cm, rounded-cuneate at the base, shortly caudate at apex, chartaceo-coriaceous, glabrous above, very shortly adpressed-pubescent below (subsericeous when young), yellowish-grey and narrowly ochraceous-margined above, and ochraceous-brown below, when dry, almost epunctate, nervation rather distinct, close, reticulate and steeply ascending; petiole rather stout, 8–10 by 2–3 mm, pubescent. *Inflorescences* small and few-flowered, 2–3 cm long, almost simple, finely adpressed-pubescent or subsericeous. Pedicels elongate, 1–2 cm, sericeous. *Flowers* rather large, cream-coloured, slightly rose-tinged when dry. *Calyx* campanulate, 8 by 10 mm, shortly adpressed-sericeous externally, divided beyond the middle; segments narrowly or broadly ovate, 6 by  $2\frac{1}{2}$ – $4\frac{1}{2}$  mm, obtuse. *Petals* c. 30, narrowly subulate, subterete below, somewhat flattened and sulcate





Fig. 4. *Gonystylus bancanus* (MIQ.) KURZ. a. Twig,  $\times 2/3$ , b. flower,  $\times 4$ , c. flower in section,  $\times 4$ , d. gynoecium,  $\times 6$ , e. stamens,  $\times 6$ , f. young fruit,  $\times 2/3$ , g. ripe fruit with 3 seeds,  $\times 2/3$ , h. seed,  $\times 2/3$  (a GRASHOFF 766, b-e ENDERT 281, f-h bb 5317).

above, c. 5 mm long, glabrous, epustulate. Style more or less setose below. Fruit unknown.

Distr. *Malaysia*: Borneo (SW. Sarawak).

Ecol. Evergreen rain-forest at 360 m; fl. Sept.

Notes. Distinguished from the other small-leaved species by the relatively large flowers with numerous petals.

**18. *Gonystylus micranthus* AIRY SHAW, Kew Bull. 1950, 142 (1950).**

Tree 18 by 0.6 m. Branches fuscous, glabrous; innovations shortly softly ochraceo-tomentellous. Leaves elliptic-oblong,  $6\frac{1}{2}$ –15 by 3–6 cm, base mostly rounded, apex abruptly caudate (cauda 6–12 mm long), chartaceo-coriaceous, with a conspicuous narrow thickened margin below, drying a purplish-lead colour, especially beneath, dull but not shagreened above, sparsely puberulous especially on the midrib below; lateral nerves numerous, conspicuous and rather crowded; petiole 8–10 by 2–3 mm. *Inflorescences* little branched, up to 10 cm long, softly shortly ochraceo-pubescent. Pedicels up to 6 mm, densely tomentellous. *Flowers* the smallest known in the genus, 4–5 mm diam. (possibly not quite mature), globose. *Sepals* ovate-deltoid, 3 by  $1\frac{1}{2}$ –2 $\frac{1}{4}$  mm, subacute, finely puberulous outside, densely silky within. *Petals* about 10, subulate, 2–3 mm, apparently with a few pustules towards the apex. Style 3–4 mm. Fruit unknown.

Distr. *Malaysia*: Borneo (Sarawak).

Ecol. Unknown; fl. Feb.

Uses. Timber for planks.

Vern. *Ramin hitam*.

Notes. Distinguished from all other species by its very small flowers, and from all except *G. calophyllus* and *G. confusus* by the purplish-lead colour of the leaves on drying. Further collections are very desirable.

**19. *Gonystylus bancanus* (Miq.) KURZ, Nat. Tijd. N.I. 27 (1864) 171, 240; BAILL. Hist. Pl. 6 (1877) 123, in adnot.; GILG in ENGL. & PR. Nat. Pfl. Fam. Nachr. 1 (1897) 232; HEYNE, Nutt. Pl. Ned. Ind. 3 (1917) 183, pro majore parte; AIRY SHAW, Kew Bull. 1947, 9 (1947), in adnot.; auctt. cet. plerisque exclusis.—*Aquilaria?* *bancana* MIQ. Fl. Ind. Bat. Suppl. (1861) 355.—*Gonystylus miquelianus* TEYSM. & BINNEND. Bot. Zeit. 20 (1862) 265, pro minore parte, quoad pl. Banc. tantum.—? *G. hackenbergii* DIELS, Bot. Jahrb. 60 (1926) 310, e descr.—Fig. 4.**

Tree, 18–42 m by 30–120 cm, with many knee-roots (pneumatophores). Branchlets blackish-grey, much branched and 'twiggy'. Leaves elliptic, short-

ly oblong-ob lanceolate or obovate, 4–14 $\frac{1}{2}$  by 2–7 cm, base broadly cuneate to rounded, apex rounded and shortly acuminate-cuspidate, firmly coriaceous, often conduplicate, margins somewhat undulate and markedly reflexed, quite glabrous, mostly drying a characteristic dull purplish ('plum') colour below and  $\pm$  chestnut or ochraceous above, appearing rather smooth, but under a lens minutely shagreened; midrib narrowly and deeply channelled above; nervation less conspicuous than in most species, moderately close above, rather lax and not sharply prominent below; petiole 8–18 by 1–2 mm, glabrous. *Inflorescences* (apparently rarely produced) subsimple, up to 9 cm long, minutely adpressedly ochraceo-puberulous. Pedicels up to  $1\frac{1}{2}$  cm, puberulous. *Calyx* shortly cupular, 5 mm long, 5–6 mm wide; sepals deltoid, 2–3 mm long, subacute. *Petals* 13–20, narrow-lanceolate, acuminate, 3 mm long, glabrous, epustulate. Style rather robust, much contorted, glabrous; stigma rather large, capitate. *Fruit* subglobose, 3-valved, valves orbicular-ovate, up to 4 cm long by  $3\frac{1}{2}$  cm wide, 3 mm thick, minutely roughened but not rugose. Seeds flattened-ovoid, 28 by 22 by 6 mm.

Distr. *Malaysia*: SW. Malay Peninsula, SE. Sumatra, Banka, Borneo.

Ecol. Lowland freshwater coastal swamps ('peat forests') (? on sandy soil), mostly subject to periodic inundation, but also in non-inundated areas, up to 100 m, sometimes forming pure stands (e.g. Rejang delta, Sarawak); occasionally in inland swamps (Selangor); fl. Feb.–March (buds also noted in May and Oct.), fr. May–June.

Uses. Timber, for planks, barrels, boxes, etc.; cf. THOMAS, Mal. For. 12 (1949) 206. Heartwood used for incense; cf. HEYNE, l.c. Inner bark contains numerous fine, brittle fibres, which break off and irritate the skin.

Vern. *Melawis*, *mampis*, *nyoreh*, *sépah petri*, *suasam* (Chinese), *langging*, Mal. Pen., *gérong-gang*, *kaju minjak*, *pulai mijang*, *sétalam*, *lapis kulit*, *matakeli*, *gèharu buaja*, Sumatra, *balun* or *balang kulit*, Riouw, *kaju bulu*, *garu anteru*, *ménameng*, *nameng*, Banka, *méntailang*, *tutong*, *ramin*, Brunei, *ramin*, Sarawak, *garu buaja*, *djung-kang adung*, *médang kéran*, *s(i)riangun*, *ménjan*, W. Borneo, *mèrang*, S. & E. Borneo.

Notes. A well-marked species, both morphologically and ecologically. The small, rigidly coriaceous leaves, often folded together along the midrib, with much less conspicuous nerves than most species, and usually drying purplish-brown below, are very characteristic. The freshwater swamp habitat appears to be almost unique in the genus.

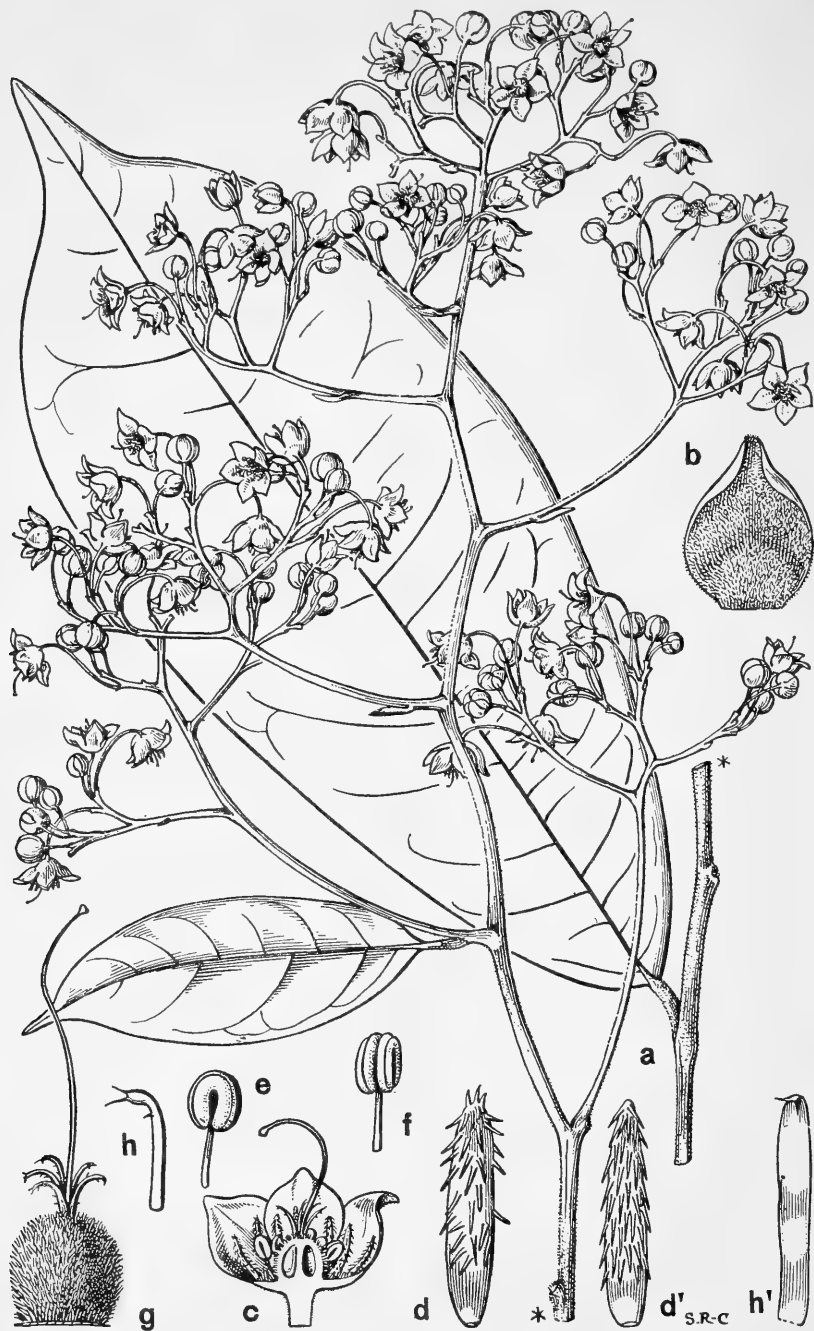


Fig. 5. *Amyxa pluricornis* (RADLK.) DOMKE. a. Flowering branch, with leaf, nat. size, b. sepal, outer surface,  $\times 6$ , c. flower, longitudinal section,  $\times 4$ , d, d'. petals,  $\times 18$ , e, f. stamens from bud, in two views,  $\times 8$ , g. gynoecium, showing parastyles,  $\times 8$ , h, h'. parastyles,  $\times 18$  (a-h, from HAVILAND 494, d' and h' from RICHARDS 1604). By courtesy of the Bentham-Moxon Trustees.

## 2. AMYXA

TIEGH. (Ann. Sc. Nat. VII, Bot., 17, 1893, 248, *descr. anat. tantum*) ex DOMKE, Bibl. Bot. 27, Heft 111 (1934) 116 *et passim*, map 1; AIRY SHAW, Kew Bull. 1940, 261 (1940); *ibid.* 1950, 146 (1950).—**Fig. 5.**

Medium-sized trees. *Leaves* alternate, petiolate, elliptic, acuminate, entire. *Flowers* small, in axillary and terminal, slender, copiously and widely branched thyrses. Bracts subtending main branches of inflorescence often carried up the branch for a short distance. Bracteoles 0. Pedicels articulate at base. *Calyx* widely cupular, segments 5, ovate-deltoid, imbricate. *Petals* 10, in pairs alternating with the calyx-segments, narrowly oblong, setulose. Stamens 10, alternating with the petals; filaments very short; anthers hippocrepiform. Ovary 3–4-locular, cells with 1 ovule. Style elongate, filiform, contorted; stigma capitate; ‘parastyles’ 3–6, short, corniform, erect-divaricate. *Fruit* a 2-seeded, thin-walled, velutinous, indehiscent (?), shortly stipitate, long-beaked capsule. Seed large, testa thinly coriaceous, smooth, funicle thickened but not expanded into an aril.

Distr. Monotypic, *Malaysia*: W. Borneo.

Notes. The genus is quite distinct from *Gonystylus* in its lax venation, diffuse inflorescence, paired petals, ‘parastyles’ and curious fruit.

1. *Amyxa pluricornis* (RADLK.) DOMKE, *l.c.* 117 *et passim*, t. 1, f. 4, t. 4, f. 35, t. 5, f. 38g; AIRY SHAW, *l.c.*; in HOOK. Ic. Pl. 35 (1947) t. 3475; Kew Bull. 1950, 146, 144, f. 2 (1950).—*Gonystylus pluricornis* RADLK. in Sitzber. Math.-Phys. Kl. Bayer. Akad. Wiss. 1886, 16 (1887) 329; HALLIER f. Med. Rijks-herb. 44 (1922) 15; ERDTMAN, Svensk Bot. Tidskr. 40 (1946) 81.—*Amyxa kutcinensis* TIEGH. Ann. Sc. Nat. VII, Bot. 17 (1893) 248, *descr. anat. tantum*.—*A. taeniocera* AIRY SHAW, Kew Bull. 1950, 146 (1950).—**Fig. 5.**

Tree, 6–18 by 0.3 m; branchlets slender, dark brown, densely fulvo-tomentellous when very young, later minutely tomentellous or glabrescent. *Leaves* elliptic to elliptic-oblong, rarely slightly oblanceolate, 6–16½ by 2–6 cm, cuneate to almost rounded at the base, shortly caudate-acuminate at apex, thinly chartaceous, minutely shagreened and densely and minutely impressed-punctate above, almost smooth below, drying various shades of light brown, from reddish to olivaceous, glabrous above and below, or very sparsely puberulous below when young, midrib slender, narrowly impressed above, prominent and shortly puberulous below; primary lateral nerves 5–11 pairs, very slender, lax, patulous; petiole slender, 8–15 mm, densely fulvo-puberulous or tomentellous. Inflorescence up to 27 cm long, often unbranched in lower portion, much branched above, densely ochraceo-tomentellous or shortly adpressed-sericeous, branches spreading almost at right angles, up to 8 cm long, each subtended by an almost linear tomentellous bract (up to 7 mm long) which is sometimes carried as much as 1½ cm up the branch, ultimate branchlets loosely subfasciculate. Pedicels slender, 5–10 mm, shortly subsericeous. *Calyx* shortly and openly cupular, 5–7 mm diam., externally sericeous, glabrous within but setulose at the base; segments ovate, rounded to subacute, ± reflexed at apex. *Petals* 2–3 mm long, strongly re-

trorse-setulose, *setae* adpressed, sometimes spreading at apex. Stamens 2 mm long. Ovary 2 mm diam., densely setulose. Style 5–6 mm, glabrous or very sparingly pilose below. ‘Parastyles’ 1–2 mm long, glabrous or very sparingly pilose above. *Fruit* prismatic-trigonal or tetragonal when young, ellipsoid-oblong when mature (?), with a long cylindric beak, 5¾–6¾ cm long (including 2–2½ cm long beak), 1–2 cm thick, shortly stipitate, densely shortly brown-velvety, traversed by the 3–4 elevate sutures; calyx persistent. *Seeds* large, oblong-ellipsoid, 3 by 1½ by 1 cm, ± plano-convex, testa thin, but firm and tough, very smooth and glossy, dark brown; funicle thickened, 36 by 3 mm, trigonous, enlarged into a conical appendage 6 mm long at base of seed; embryo about 23 by 11 by 9 mm; cotyledons thick and fleshy, with numerous oil-ducts; radicle conical, blunt; plumule not detected.

Distr. *Malaysia*: Borneo (W. Indonesian Borneo, SW. & Central Sarawak).

Ecol. Primary non-inundated rain-forest at low or medium altitudes; *fl.* April, May, July, Sept.; *fr.* July.

Uses. Wood used for planks (SW. Sarawak).

Vern. *Sengabei*, W. Indonesian Borneo, *ramin batu*, *ramin bukit*, *soma merah*, Sarawak.

Notes. The above record from W. Indonesian Borneo rests on a sterile specimen (bb. 17136) from G. Belungei; the generic attribution is beyond doubt, but the species should be checked in due course from more complete material.

*A. taeniocera* A.S. must be reduced to synonymy; the supposed differences from *A. pluricornis* break down upon examination of further material, though the range of indumentum is striking.

The foliage of *Amyxa* is somewhat reminiscent of *Erycibe* spp. (*Convolvulaceae*), in the dried state. The sericeous indumentum of the inflorescence also suggests that of certain *Convolvulaceae*.

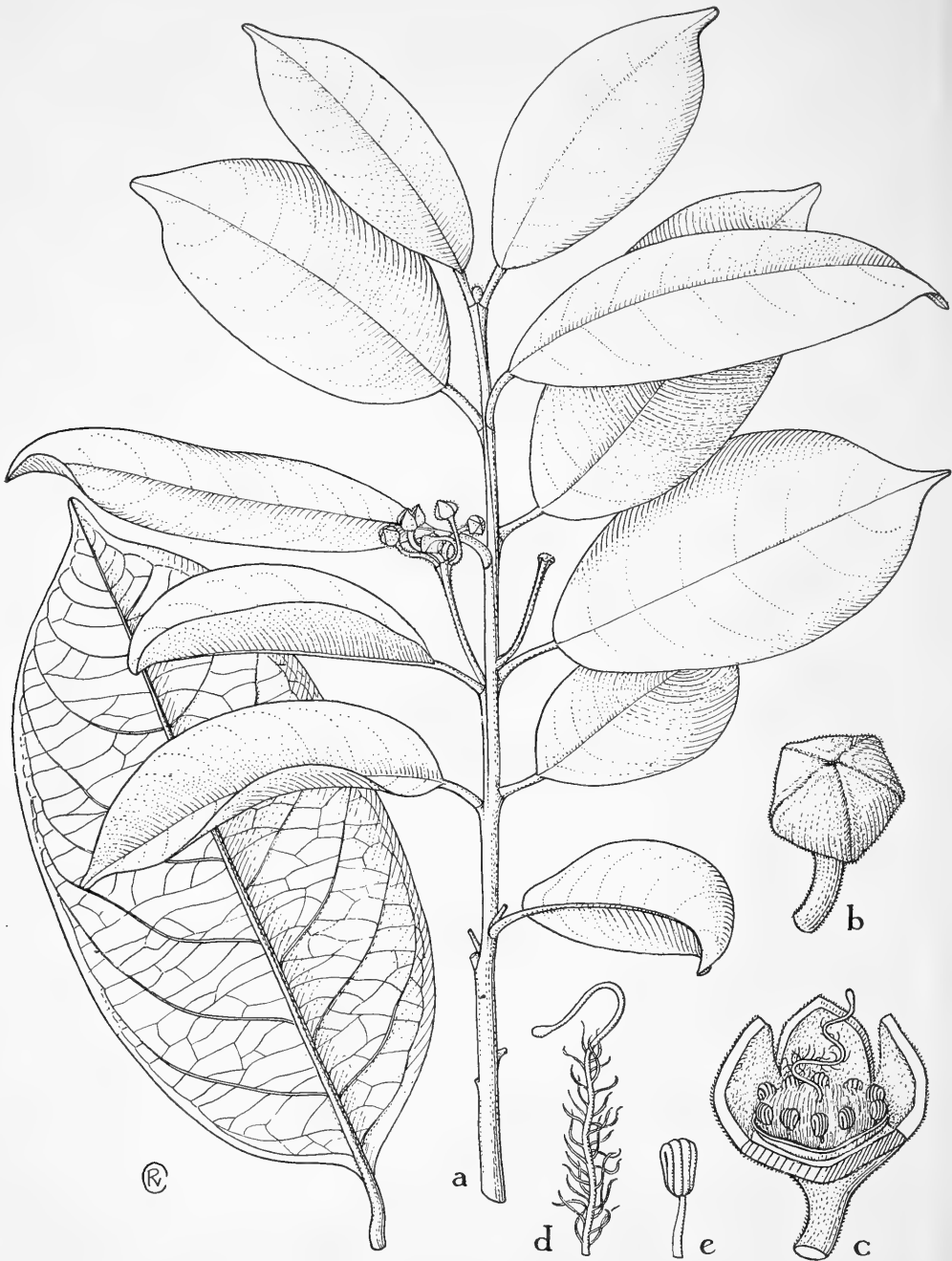


Fig. 6. *Aëtoxylon sympetalum* (STEEN. & DOMKE) AIRY SHAW. *a.* flowering twig,  $\times \frac{4}{5}$ , *b.* bud,  $\times 7$ , *c.* young flower, two sepals removed,  $\times 7$ , *d.* style,  $\times 16$ , *e.* stamen,  $\times 16$  (after bb. 17222, loose leaf after bb. 16646).

## 3. AËTOXYLON

AIRY SHAW, Kew Bull. 1950, 145 (1950).—*Gonystylus* sect. *Aëtoxylon* AIRY SHAW, Kew Bull. 1947, 10 (1947).—Fig. 6.

Medium-sized tree. *Leaves* opposite or subopposite, coriaceous, glabrous. *Inflorescence* an axillary, peduncled, false-umbel. Bracts 0? *Flowers* long-pedicelled. *Calyx* cupular, divided to about half-way; segments valvate, slightly reduplicate, equal, setulose within. *Corolla* represented by a low, entire, slightly fleshy annulus. Stamens 10–15; filaments very short and slender; anthers hippocrepiform. Ovary sessile, ovoid, 3–5-locular, densely setulose. Style elongate, filiform, wiry, contorted, pilose; stigma capitate. *Fruit* a 1-seeded, rather thin-walled, velutinous, indehiscent, subglobose capsule. Seed large; testa coriaceous, roughened; funicle and aril not seen.

Distr. Monotypic, *Malaysia*: Borneo.

Notes. The opposite or subopposite leaves (and branching), curious venation, pseudo-umbellate inflorescence, reduplicate-valvate calyx-segments, and annuliform corolla, separate this genus sharply from *Gonystylus*. The fruit also appears to be of a basically different type.

1. *Aëtoxylon sympetalum* (STEEN. & DOMKE) AIRY SHAW, Kew Bull. 1950, 145, tt. 5 & 6 (1950).—*Gonystylus sympetala* STEEN. & DOMKE, Notizbl. Bot. Gart. Berlin 12 (1934) 233; DOMKE, Bibl. Bot. 27, Heft 111 (1934) 7, 33, 145, t. 1, f. 3; AIRY SHAW, Kew Bull. 1947, 10 (1947).—Fig. 6.

Tree, 18–35 by  $1\frac{1}{4}$ – $3\frac{1}{4}$  m. Bark containing scanty white sap. Branchlets robust, dark brown or blackish, innovations very shortly ochraceo-tomentellous. *Leaves* obovate, less frequently elliptic-oblong, base rounded to very broadly cuneate, apex rounded and shortly obtusely cuspidate, 5–10(–12) by  $2\frac{1}{2}$ – $5\frac{1}{2}$  cm, firmly coriaceous, very glossy when living, rather dull when dry, but smooth, and punctulate-shagreened above, glabrous, drying ochraceous-brown, margin flat or almost so; midrib rather slender, narrowly impressed above; nervation inconspicuous or quite obscure above, lax and often rather indistinct below, not sharply raised from the mesophyll but sloping gradually into it, as though smoothed off, spreading widely from the midrib but curving strongly forwards and freely anastomosing; the general effect suggesting species of *Ficus* § *Sycidium*, or of *Stemonurus* (*Icacinaeae*), e.g. *S. scorioides* BECC.; petiole 6–10 by 1– $2\frac{1}{2}$  mm, shortly tomentellous when young. *Peduncles* patulous, patent or even deflexed, straight, 8–30 mm, grooved, tomentellous, gradually expanded upwards, suddenly enlarged at the apex into a nodose-discoid structure 2–3 mm in diam. (rarely itself very shortly branched) bearing the flowers. False umbel 5–6-flowered. Pedicels 8–10 mm long, tomentellous. *Flowers* cupular, globose-pentagonal in bud, 4–5 mm in diam., tomentellous.

*Calyx* divided about half-way, densely setulose within; segments deltoid, acute, margins slightly reduplicate. Corolline annulus barely 1 mm high, glabrous. Filaments 1 mm long; anthers about 0.8 mm long. Ovary ovoid,  $1\frac{1}{2}$  mm long, narrowed upwards, densely setulose; style about 3 mm long, long-pilose in lower part; stigma clavate-capitate. *Fruit* (immature) irregularly subglobose, substipitate, up to 3 by 2 by 1 cm, shallowly tricostate, verruculose, very shortly brown-velutinous; pericarp 2 mm thick, with copious resin-canals; pedicel  $1\frac{1}{2}$  cm long; calyx persistent, not enlarged. Seed ellipsoid, 23 by 15 by 13 mm; embryo unknown.

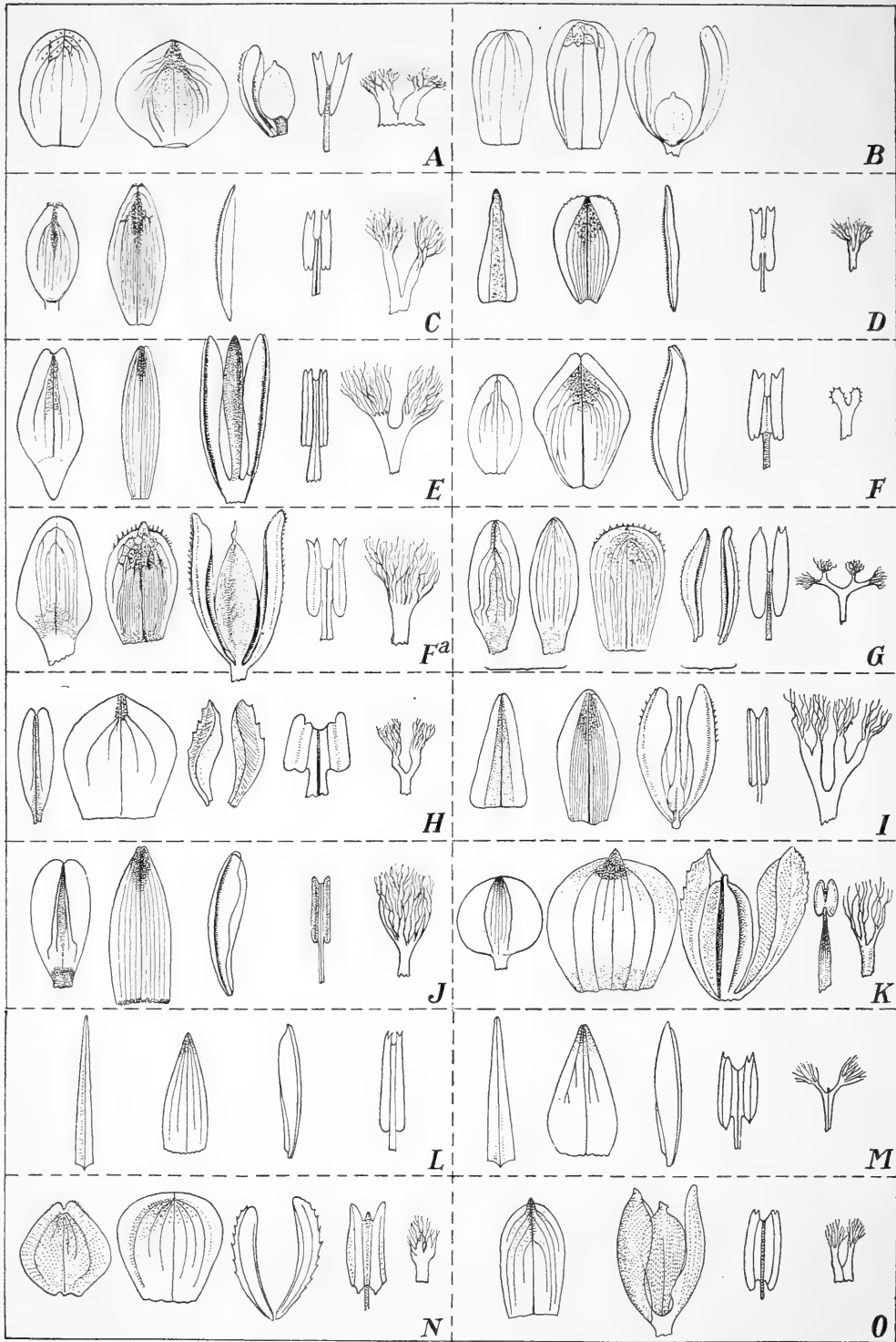
Distr. *Malaysia*: Borneo (W. Indonesian Borneo, SW. Sarawak).

Ecol. Low, level, sandy ground, in primary non-inundated rain-forest, up to 100 m, locally rather common; fl. Dec., fr. March.

Uses. Oil (*minjak garu-laka*) obtained from heartwood for incense; cf. VAN STEENIS & DOMKE, l.c..

Vern. *Kayu bidaroh, kayu laka, garu laka, garu buaja, mēlabajan*, Indon. Borneo, *ramin batu*, Sarawak.

Notes. The general resemblance of the vegetative parts to *Stemonurus* is striking; this genus is also characterized by umbellately arranged inflorescence branches. The inflorescence of *Aëtoxylon* appears to represent an extreme simplification and condensation from the *Gonystylus* type. The corolline annulus is somewhat fleshy, rather than membranous as stated by DOMKE. Ripe fruiting material of this tree is very desirable, as the interior of the only fruit examined was damaged and it was not possible to interpret the contents of the seed.



# XYRIDACEAE (P. van Royen, Leyden)

## XYRIS

LINNÉ, Sp. Pl. (1753) 42; Gen. Pl. ed. 5 (1762) no 64; NILSSON, Kongl. Svenska Vet.-Akad. Handl. 24, 14 (1892) 1-75, pl. 1-6; MALME, Svensk Bot. Tidskr. 21 (1927) 381-396; MALME, Bull. Jard. Bot. Btztg III, 10 (1929) 385-392; MALME, in ENGLER & PRANTL, Nat. Pfl. Fam. ed. 2, 15a (1930) 35-38.

Mostly perennial, paludose, grass-like *herbs* with fibrous roots; stembase very rarely thickened, often profusely producing shoots. *Leaves* basal, distichous on each shoot, ensiform, linear or filiform, sometimes twisted; sheaths with a membranous margin (in *Mal. spp.*) producing mucilage (?always), with or without a short ligule; limb glabrous or with numerous, small hard papillae, sometimes with a stout nerve in either margin. *Flowers* ♂, in terminal, few- to many-flowered heads, 3-merous, yellow to white, ephemeral, each in the axil of a conspicuous bract; bracts conchate, imbricate, spirally arranged, lower ones sterile; one to few flowers simultaneously in anthesis. Peduncles scape-like, terete to compressed, sometimes winged or ribbed, glabrous or with numerous hard papillae, at the base with some sheaths provided with a short limb. *Bracts* entire, ciliate, fimbriate or lacerate, with one complete main nerve and some complete or incomplete longitudinal secondary (descending) nerves, in the apical part mostly with a small minutely-papillose field. *Calyx* zygomorphic; lateral sepals navicular, with entire, dentate or ciliate crest, wings membranous, entire, glabrous or ciliate; median sepal membranous, spathe-liform or cap-shaped, enveloping the corolla, mostly obovate, 1-3(-5)-nerved, pushed out by the corolla in anthesis (?always). *Corolla* actinomorphic, ephemeral; petals with an orbicular to obovate limb and a long, narrow claw, free, cohering mutually or by the staminodes. *Stamens* mostly 3 fertile epipetalous inserted on the petals and 3 alternating staminodes, staminodes rarely absent, or all stamens fertile; filaments short; anthers basifix, dehiscing lengthwise extrorsely. *Ovary* superior, sessile to stipitate (in Australian *spp.* sometimes with 3 hard swellings at the top), 1- or 3-celled, or incompletely 3-celled. Placentas parietal, central, or basal, with  $\infty$  ovules; styles filiform, apex 3-fid, stigmas mostly capitate. *Fruit* shape similar to that of the ovary but larger, loculicidally 3-valved. Seeds ellipsoid to obovoid, often ribbed, with a long funicle.

Distr. *Xyridaceae* are confined to the tropics throughout the world including the southern parts of North America; east of *Malaysia* and Australia hitherto only recorded from the Palau group (Korror) and New Caledonia.

*Xyridaceae* contain only two genera, *Xyris* and *Abolboda*; the latter genus possesses blue flowers and is restricted to South America.

Some *spp.* of *Xyris* are spread over large areas, e.g. *X. capensis*, *X. complanata*, and *X. indica*. On the whole, however, the species occupy limited areas.

Ecol. Restricted to marshy habitats, often on sandy, acid soils together with *Cyperaceae*, *Eriocaulon*, *Drosera*, *Juncus*, etc., and on borders of shallow swamps; locally they are often very common or even subgregarious. Single species are common in wet rice-fields, e.g. *X. indica*, which seems to be almost restricted to this anthropogenic habitat.

Fig. 1. A. *X. complanata*, B. *X. tuberosa*, C. *X. bancana* var. *lacerata*, D. *X. borneensis*, E. *X. malmei*, F. *X. ridleyi* var. *ridleyi*, Fa. *X. ridleyi* var. *penicillata*, G. *X. papuana*, H. *X. pauciflora*, I. *X. lobbii* var. *lobbii*, J. *X. oreophila*, K. *X. dajacensis*, L. *X. grandis*, M. *X. chlorocephala*, N. *X. indica* var. *indica*, O. *X. capensis* var. *schoenoides*.

The figures show from left to right: basal bract, median bract, lateral sepal(s), with or without ovary, stamen, staminode. In O the basal and median bracts are of the same shape. In G two types of basal bracts are given. In B stamens and staminodes are unknown. In L (*X. grandis*) staminodes do not occur.

The figures are not drawn on the same scale.



Most *spp.* occur in the lowland, but several are bound to mountain marshes, e.g. *X. flabellata*, *X. grandis*, and *X. oreophila*.

According to BEUMÉE (Trop. Natuur 6, 1917, 158) the sheaths of *X. indica* are filled with mucilage which originates from the disintegrating parenchymatic tissue between the vessels of the membranous marginal parts of the sheaths. This phenomenon may, possibly, occur in other species.

BEUMÉE also observed an undescribed particularity of the anthesis, namely that in the early morning the expanding corolla pushes (and detaches) the cap-shaped median sepal from its insertion and presses it outside the bracts of the head, where it, subsequently, is blown away by the air. This explains why, in herbarium specimens, it is never found in open flowers, and has been termed caducous. In *X. lobbii* it is, for this reason, as yet unknown.

Notes. The term 'descending nerves' used in this revision indicates that the side-nerves running downwards from the midrib of the bracts are incomplete and do not reach the base of the bract: this character has proved to be useful in specific delimitation.

With the length of the staminodes is meant the length of the free part, not including the length over which they are coherent with the claw of the petals.

All Malaysian species belong to § *Euxyris*.

#### KEY TO THE SPECIES

1. Peduncle terete or subterete in the upper part, neither winged nor ribbed when dry.
  2. Dried leaves with numerous short, transverse, prominent ribs connecting the longitudinal veins, 5–60 cm by 3–10 mm; top falcate. Sheath 8–30 cm long. Midrib of the bracts with 4–6 descending nerves. Fig. 1 N . . . . . 14. *X. indica*
  2. Leaves without transverse ribs.
    3. Stem-base provided with subglobose tubers between the roots. Bracts with *ca* 4 complete nerves besides the midrib. Incompletely known species. Fig. 1 B . . . . . 2. *X. tuberosa*
    3. Stem-base without tubers.
      4. Lateral sepals ciliate or serrate in the upper half.
        5. Leaves linear, twisted, without thickened marginal ribs. Anther-cells produced above the connective, each with 2 acute teeth. Fig. 1 D . . . . . 4. *X. borneensis*
        5. Leaves ensiform, not or slightly twisted, with distinct thickened marginal ribs.
          6. Anther-cells acute. Papillae on median bracts in a narrow quadrangular field in the apical half. Midrib of median bracts provided with *ca* 14 subcomplete descending nerves. Fig. 1 I. 9. *X. lobbii*
          6. Anther-cells obtusely 2-tipped. Papillae on median bracts in a triangle in the upper third part. Midrib of median bracts provided with 4 partly complete, partly incomplete descending nerves. Fig. 1 H . . . . . 8. *X. pauciflora*
      4. Lateral sepals entire.
        7. Leaves acuminate. Midrib of bracts with 5–10 complete nerves. Anther-cells produced above the connective, acute. Fig. 1 J . . . . . 10. *X. oreophila*
        7. Leaves obtuse. Bracts with *ca* 6 complete and *ca* 2 descending nerves. Anther-cells produced above the connective, 2-tipped. Fig. 1 E . . . . . 5. *X. malmei*
  1. Peduncle compressed or subterete, with one or more wings or ribs when dry.
    8. Dried leaves with numerous short, transversal, prominent ribs connecting the longitudinal veins. Fig. 1 N . . . . . 14. *X. indica*
    8. Dried leaves without such ribs.
      9. Staminodes absent. Upper part of bracts with a small triangular field of small papillae. Head brownish. Fig. 1 L . . . . . 12. *X. grandis*
      9. Staminodes present.
        10. Bracts without a papillate field.
          11. Head greenish. Midrib of median bract with 2 descending forked nerves. Leaves 6–18 mm wide. Fig. 1 M . . . . . 13. *X. chlorocephala*
          11. Head blackish or brown. Midrib of median bract with 6–9 partly complete and partly incomplete nerves. Leaves 2–4 mm wide. Fig. 1 O . . . . . 15. *X. capensis* var. *schoenoides*
        10. Bracts with a papillate field.
          12. Bracts with a subapical, dorsal, hollow minutely papillate tooth. Fig. 1 K . . . . . 11. *X. dajacensis*
          12. Bracts without such a tooth, sometimes keeled.
            13. Leaves with thickened, in section sometimes hollow tubular margins.
              14. Bracts orbicular to 1½ times as long as broad. Crest of lateral sepals lacerate-fimbriate in the upper part. Upper half of anther-cells free. Leaves 10–50 cm long, spread. Fig. 1 A.
                1. *X. complanata*
              14. Bracts twice as long as broad. Crest of lateral sepals entire. Anther-cells connate to the apex. Leaves 2½–9½ cm long, equitant. Fig. 10 . . . . . 16. *X. flabellata*

18. Leaf flattened in section, as is the central tissue.  
 19. Staminodes penicillate. Median bracts with numerous (25–35) nerves.  
 20. Peduncle with a few ribs. Median bracts with a narrow-elliptic papillate field. Base of anther-cells not free, emarginate. Fig. 1 C. . . . . 3. *X. bancana* var. *lacerata*  
 20. Peduncle with 2 wings. Median bracts with a broad quadrangular papillate field. Base of anther-cells free, not emarginate. Fig. 1 Fa . . . . . 6. *X. ridleyi* var. *penicillata*  
 19. Staminodes sparsely short-ciliate. Median bracts with ca 11 nerves. Fig. 1 F. . . . . 6. *X. ridleyi* var. *ridleyi*  
 18. Leaf terete or subterete in section, as is the central tissue. Sheath 2–5 cm, blade 8–25 cm. Fig. 1 D . . . . . 4. *X. borneensis*  
 17. Crest of lateral sepals sparsely tuberculate. Fig. 1 G. . . . . 7. *X. papuana*  
 16. Median bracts entire and glabrous at the top.  
 21. Lateral sepals coarsely serrate. Fig. 1 H . . . . . 8. *X. pauciflora*  
 21. Lateral sepals finely ciliate-tuberculate. . . . . 3. *X. bancana* var. *bancana*  
 15. Crest of lateral sepals entire. Anther-cells acute. Fig. 1 J . . . . . 10. *X. oreophila*

1. *Xyris complanata* R. BROWN, Prodr. 1 (1810) 256; NILSSON, l.c. 29; MALME, l.c. (1927) 389; l.c. (1929) 387.—*X. anceps* (non LAMK) VAHL, En. Pl. 1 (1805) 205.—*X. elongata* RUDGE, Trans. Linn. Soc. 10 (1811) 289, t. 15, f. 1.—*X. walkeri* KUNTH, En. Pl. 4 (1843) 19; MIQUEL, Fl. Ind. Bat., Suppl. (1861) 608.—*X. malaccensis* STEUDEL, Syn. Pl. Glum. 2 (1855) 287.—Fig. 1 A, 2.

Perennial. Leaves rigid, linear, 10–50 cm by  $1\frac{1}{2}$ – $3\frac{1}{2}$  mm, acute, often falcate, twisted, widened at the base, striate when dry, with a stout nerve in either margin, which is scabrous but for the basal part. Sheaths narrow, 3–7 cm, slightly crested. Peduncle 10–60 cm by  $2\frac{1}{2}$ –3 mm, distinctly compressed, twisted, with a stout, scabrous rib in either margin. Head oblong-ovoid to cylindrical, 5–25 by 4–7 mm. Basal bracts elliptic, 2–4 by 2–3 mm, with ca 7 descending nerves; median bracts elliptic to orbicular, 5–6 by 4–6 mm, sometimes with a prominent keel, central part subspinulose at the top, papillate in a triangular field in the upper half, entire or emarginate at the top, with ca 15 descending nerves. Lateral sepals 4–5 by  $1\frac{1}{2}$  mm, obtuse, top sometimes scarious, crest lacerate-fimbriate in the upper half, sometimes exceeding the top; median sepal cap-shaped, 3– $3\frac{1}{2}$  mm long, with 1 or 3 nerves. Petals 5–6 mm long, limb obtriangular to obovate, ca 3 mm by 3–4 mm, apical margin lacerate, claw  $2\frac{1}{2}$ –3 by  $ca\ \frac{1}{5}$  mm. Stamens 2– $2\frac{1}{2}$  mm, filament ca 1 mm; anthers  $1\frac{1}{2}$ –2 mm, deeply incised at the top, cells with 2 acute tips, base mucronulate or with 2 acute tips. Staminodes bifid, penicillate, ca 1 mm long. Ovary obovoid, 3-sided, ca 2 by 1 mm. Styles 3-fid, 3–5 mm, arms ca 1 mm, infundibuliform at the top, with lacerate margins. Fruit 3– $3\frac{1}{2}$  by  $2\frac{1}{2}$ –3 mm.

Distr. Ceylon, India, China, Hainan to Australia, throughout Malaysia, not yet collected in the Moluccas, Java, the Lesser Sunda Islands, only once collected in Sumatra (Palembang), and only once in Celebes (Makale).

Ecol. Mainly in the coastal areas in damp sandy places, in open dune hollows (Pahang), in peaty swamps (Palembang), in damp situations in savannahs (East New Guinea), in West Malaysia mostly on open sandy padang soils, at low altitude below 150 m, except in Central Celebes (Makale) at 1500 m and West New Guinea at 1600 m (Balim), fl. April–Jan..

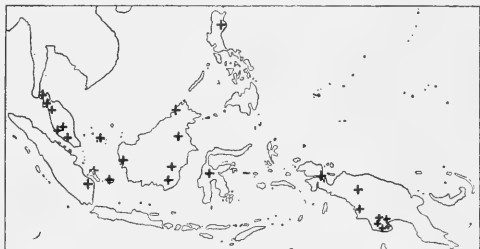


Fig. 2. Distribution of *Xyris complanata* R.Br. in Malaysia.

Vern. *Chelagi*, *berudang*, Mal. Pen., *djangot tutu*, Billiton, *purum bili bili*, Kutai, *gumi-gumi*, Tagalog.

Notes. Rather variable in shape and size of peduncle, head and leaves, but is recognizable by the stout nerves in the margins of the leaf.

2. *Xyris tuberosa* RIDLEY, J. Fed. Mal. St. Mus. 10 (1920) 122; MALME, l.c. (1927) 390; l.c. (1929) 385.—Fig. 1 B.

Stembase with globose, pubescent or glabrous tubers up to 8 mm diam.. Leaves ensiform, 20–25 cm by  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm, falcate, acute, widened at the base, papillate. Sheaths 6–7 cm. Peduncle 30–40 cm, terete, with numerous black papillae. Head ovoid to globose, 8–10 by 8–10 mm. Bracts elliptic, 6–7 by 3–4 mm, obtuse to truncate, papillate in the upper fourth, with 4–8 complete nerves (incomplete in the basal bracts). Lateral sepals narrow, 4–5 by ca 1 mm, obtuse, crest tapering towards the base. Ovary urceolate, shortly stipitate, 3-sided, 2–3 by ca 2 mm.

Distr. Malaysia: Malay Peninsula, 'mainland shores'.

Notes. Differing from all other spp. by stembase tubers. The material is too scarce to judge whether these are a normal feature. In North America *X. torta* SMITH is bulbous, but in this species the stembase itself is thickened and no separate tubers are found between the roots.

3. *Xyris bancana* MIQUEL, Fl. Ind. Bat., Suppl. (1861) 608; NILSSON, l.c. 37; MALME, l.c. (1927) 390; l.c. (1929) 388.  
var. *bancana*.

Tufted. *Leaves* acrose-ensiform, 2–7 cm by *ca* 1 mm, acute, falcate; sheath 1–1½ cm; basal leaves with a distinct, finely ciliate crest and small, reduced limb; apical leaves similar to the basal ones, with one or two sheaths. Peduncle 10–30 cm by 1 mm or less, terete to subterete, with a few prominent ribs in the upper part, glabrous. Head ellipsoid to subglobose, 2–4 by 1–5 mm. *Bracts* boat-shaped, elliptic to obovate, 4–5 by 1½–2½ mm, emarginate, central part with numerous papillae over the whole length and slightly crested, with numerous descending nerves; margins membranous. Lateral *sepals* 3–4 mm long, obtuse, with a ciliate inconspicuous crest; median sepal cap-shaped, minutely tuberculate at the top. *Petals* 4–5 mm long, limb obovate, *ca* 2½ mm diam., claw 2–3 mm. *Stamens* 3 or 6, ½–2 mm long; anthers 1–1½ mm long, apex deeply incised; cells with 2 acute tips, base obtuse, emarginate. *Staminodes* bifid, penicillate, *ca* 1½ mm long, or absent. Ovary ellipsoid to obovoid, obtuse, 3-sided, 3-celled, *ca* 2 mm by 1 mm. Styles 3-fid, 1–1½ mm, stigmas capitate. Fruit 3–3½ mm long.

Distr. *Malaysia*: Banka & Billiton.

Ecol. On sandy, open padang soils in the lowland, fl. Oct. (once noted).

var. *lacerata* MALME (Bull. Jard. Bot. Btzig III, 10, 1929, 388, descr.) var. nov.—Fig. 1 C.

Differs from the type-variety in the narrower leaves (1½–¾ mm wide), the flexuose or spirally twisted peduncle, and the lacerate apical margin of the bracts.

Distr. *Malaysia*: Malay Peninsula.

4. *Xyris borneensis* RENDLE, J. Bot. 37 (1899) 506, pl. 403, f. 11; MALME, l.c. (1927) 390; l.c. (1929) 387.—Fig. 1 D.

*Leaves* wiry, 8–25 cm by ½–1¼ mm, twisted, acute, glabrous to scabrous, striate when dry; sheath 2–5 cm, widened at the base up to 6 mm. Peduncle 13–40 cm by *ca* 1 mm, terete or subterete, with 0 to 3 wings, twisted, scabrous. Head ovoid to ellipsoid, 3–7 by 2–6 mm. Basal *bracts* triangular, acute, margin membranous, the central part papillate from top to base, 3–3½ by *ca* 1½ mm. Median bracts concave, obovate, 4½–5½ mm by *ca* 2½ mm with numerous complete nerves, papillate in a quadrangular region in the upper half, apical margin lacerate. Lateral *sepals* narrow, *ca* 5 by ½ mm, emarginate at the top, crest ciliate at least in the upper half, wings ciliate in the apical part. Median sepal spatheiform, membranous, 2½–3 by *ca* 1 mm, papillate at the top, with one distinct nerve. *Petals* 7–8 mm long, limb narrowly obovate-elliptic, *ca* 3 by 2½ mm, claw 4–5 mm long, ⅓ mm wide or less. *Stamens* *ca* 1½ mm long; anthers *ca* 1 mm long, top and base deeply incised, top of the cells with 2 acute teeth, base subobtuse. *Staminodes* bifid, penicillate, *ca* 1 mm long. Ovary obovoid, 3-sided, 3-celled, 2–3 by ½–2 mm. Styles 3-fid, up to 3 mm, 3-sided, branches 1–1½ mm, 3-sided, capitate at the top.

Distr. *Malaysia*: Borneo, Banka, and Billiton.

Ecol. On open sandy padang soils in the lowland, fl. Aug.–Jan. (once noted).

5. *Xyris malmey* VAN ROYEN, Blumea 7 (1953) 307.—Fig. 1 E.

*Leaves* ensiform, 7–30 cm by 1–2 mm, striate when dry, subfalcate, obtuse, widened at the base and the margins there sometimes with brown hairs, papillate; sheath 4–7 cm long. Peduncle 20–45 cm by *ca* 1 mm, terete, but subterete immediately below the head, papillate. Head subglobose to ellipsoid, 7–12 by 3–10 mm. Basal *bracts* ovate, 4–5 by 2½–3 mm, obtuse, retuse, with 4 descending nerves, papillate in a narrow region in the upper half. Median bracts ellipsoid, 8–9 by 3–4 mm, with *ca* 6 complete and *ca* 2 incomplete descending nerves, papillate in a narrow region in the upper third. Lateral *sepals* 8–9 by *ca* 1½ mm, obtuse, emarginate, crest narrow, entire. Median sepal cap-shaped, 6½–8 by *ca* 2 mm, 1-nerved. *Petals* 15–17 mm long, limb obovate, 8–9 by 5–6 mm, claw 7–8 mm. *Stamens* 3–4½ mm, anthers 2–2½ mm, deeply incised at the top; cells with 2 acute tips, base obtuse, emarginate. *Staminodes* 2–3 mm, bifid, penicillate. Ovary obovoid, 3-sided, *ca* 3 by 1 mm, stipitate. Styles 11–12 mm, 3-fid, 3-sided, branches 3–3½ mm, capitate at the top.

Distr. *Malaysia*: Malay Peninsula (Kedah Peak), 850–1300 m.

Notes. This species has characters in common with *X. bancana*, *X. oreophila* and *X. lobbii*. From *X. lobbii* it differs in the obtuse leaves without thickened margins, in the terete to subterete peduncle without ribs, in the narrow entire crest of the lateral sepals and in the top of the thecae. From *X. oreophila* it differs in the divided top and base of the thecae and the narrow papillate field in the apical third of the bracts. It differs from *X. bancana* in the non-ribbed peduncle, in the entire crest of the lateral sepals, and in the relatively longer sheath of the leaf.

6. *Xyris ridleyi* RENDLE, J. Bot. 38 (1899) 505, t. 409, f. 12–16; RIDLEY, Fl. Mal. Pen. 4 (1924) 349; MALME, l.c. (1927) 390; l.c. (1929) 385, 389.—*X. glauccella* MALME, l.c. (1929) 388.—Fig. 1 F.

var. *ridleyi*.

*Leaves* linear to ensiform, 3–20 cm by *ca* 1 mm, acute, sometimes shortly spinulose, falcate, twisted, densely papillate; sheath 1–3 cm. Peduncle subterete to compressed, with 2 wings, 10–45 cm by *ca* 1 mm, twisted, subscabrous or glabrous. Head globose to obovoid, 3–10 by 6–8 mm. *Bracts* elliptic, 2–3 by *ca* 1½ mm, obtuse, emarginate, with *ca* 11 descending or complete nerves, but 3–5 branched descending nerves in the basal ones, sometimes keeled in the upper third, papillate in the upper half, apical margin minutely fimbriate, the most apical bracts with longly fimbriate apical margin. Lateral *sepals* 3½–6 by *ca* 1 mm, obtuse, emarginate, crest papillate, wings fimbriate along the margin in the upper half. Median sepal spatheiform, 3–4 mm long, with one distinct nerve, papillate at the top. *Petals* 3–6 mm long, limb orbicular, 2–3 mm long, claw *ca* 3 mm. *Stamens* 1½–2½ mm, filaments *ca* 1 mm, anthers *ca* 1 mm, deeply emarginate at the top, broadly emarginate at the base; cells with 2 acute tips, base obtuse, emarginate, the

inner lobes shorter than the outer ones. *Staminodes* 2-fid,  $1\frac{1}{2}$ –1 mm, each arm spatulate, shortly fimbriate along the margin. Ovary obovoid, truncate, 3-sided, 1-celled,  $3\text{--}3\frac{1}{2}$  by 1–2 mm. Styles 3–4 mm long, 3-fid, arms *ca* 1 mm, their top infundibuliform with an irregularly fimbriate margin.

Distr. *Malaysia*: Malay Peninsula (G. Tahan).

Ecol. 1700–2300 m, fl. June, Sept..

Notes. By the shape of its staminodes this variety is relatively easy to recognize.

var. *penicillata* VAN ROYEN, *Blumea* 7 (1953) 309.—Fig. 1 Fa.

Staminodes penicillate.

Distr. Cambodia & Siam.

Note. It is possible that this variety will be found in the Malay Peninsula.

7. *Xyris papuana* VAN ROYEN, *Blumea* 7 (1953) 307.—Fig. 1 G.

*Leaves* linear-ensiform, twisted, obtuse, 20–45 cm by *ca*  $\frac{1}{2}$  mm, striate when dry, minutely tuberculate; sheath 1–2 cm long; ligule short, obtuse,  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm long. Peduncle 20–55 cm,  $\frac{1}{2}$ – $\frac{3}{4}$  mm wide, subterete, twisted, with one or more prominent ribs when dry. Head ovoid, 3–8 by 3–6 mm. Basal bracts ovate, 2–3 by  $1\frac{1}{2}$ –2 mm, with a few descending nerves, apical margin lacerate. Median bracts obovate, 4–5 by  $3\text{--}3\frac{1}{2}$  mm, with 14 descending branched nerves, minutely papillate in the apical third, apical margin ciliate. Lateral sepals narrow,  $4\frac{1}{2}$ –5 by *ca*  $\frac{3}{4}$  mm, obtuse, emarginate, ciliate at the top, crest narrow, with small teeth or entire, wings in the apical part ciliate. Median sepal cap-shaped, *ca* 3 mm long, with 3 nerves of which 2 are sometimes incomplete. *Petals* 7–9 mm long, limb cuneate, margin crenulate, *ca* 3 mm diam., claw 5–6 mm. *Stamens*  $1\frac{1}{2}$ –2 mm, anthers *ca* 1 mm, top deeply incised; top of the thecae with 1–2 acute teeth, base subobtuse to mucronate. *Staminodes* 6–7 mm, twice forked, penicillate. Ovary obovoid,  $1\frac{1}{2}$ – $2\frac{1}{2}$  by *ca*  $\frac{4}{5}$  mm, truncate, 3-sided, 3-celled. Style 4– $\frac{1}{2}$  mm, 3-sided, 3-fid, each branch  $1\frac{1}{2}$ –2 mm, 3-sided, capitate at the top.

Distr. *Malaysia*: Moluccas (Misool, and Trang-an in Aru Islands) and N. New Guinea (Mt Cyclops).

Ecol. Alang-fields at low alt. (Misool) and mountain summits (Mt Cyclops) at *ca* 1900 m, fl. July, Oct..

Notes. This species is closely related to *X. bancana*, *X. lobbii*, *X. ridleyi*, and *X. borneensis*, but its short sheath in relation to the long leaves, the lacerate apical margin of the median bracts, and the numerous descending nerves in these bracts are good distinctive characters.

8. *Xyris pauciflora* WILLD. *Phytogr.* 1 (1794) 2, t. 1, f. 1; NILSSON, *l.c.* 36; MALME, *l.c.* (1927) 391; *l.c.* (1929) 389.—*X. pauciflora* WILLD. var. *oryzeturum* MIQUEL, *Fl. Ind. Bat.* 3 (1855) 529.—Fig. 1 H, 3.

*Leaves* narrowly linear, 3–25 cm by 1–2 mm, acute to acuminate, striate when dry, sparsely papillate at either side, sometimes restricted to the margin only in mature leaves; sheath  $1\frac{1}{2}$ –7 cm

long with a scabrous keel. Peduncle subterete, compressed and sometimes with 2 narrow wings, twisted, 4–40 cm by 1– $1\frac{1}{2}$  mm. Head ovoid to globose, 3–9 by 2–8 mm. Basal bracts elliptic, 2–4 by 2–3 mm, obtuse, emarginate, papillate along the midrib, with 2 descending nerves; median bracts elliptic to orbicular or obovate, 3–6 by 4–5 mm, obtuse, with 4 partly complete or incomplete descending nerves and a narrow papillate triangle in the upper third, spinulose at the top, margins mem-

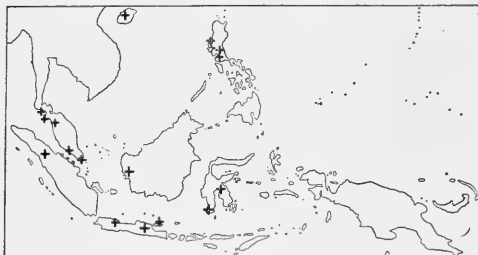


Fig. 3. Distribution of *Xyris pauciflora* WILLD. in Malaysia.

branous. Lateral sepals curved, 3–5 by  $1\frac{1}{2}$  mm, subacute, crest narrow, coarsely serrate, wings unequal, tapering towards the base. Median sepal spatheiform, *ca* 3 mm long. *Petals* 6–9 mm long, limb obovate,  $2\text{--}3\frac{1}{2}$  mm, claw 4–5 mm. *Stamens*  $1\text{--}1\frac{1}{2}$  mm, anthers  $\frac{1}{2}$ – $\frac{3}{4}$  by *ca*  $\frac{1}{2}$  mm; inner loculi of the thecae shorter than the outer ones, obtuse, connective membranously widened. *Staminodes* 2-forked, penicillate, *ca* 1 mm long. Ovary obovoid, 3-sided, 2–3 by 1 mm. Style 3-fid, 2 mm long, branches *ca*  $\frac{1}{2}$  mm, capitate.

Distr. Ceylon, India, SE. China, Hainan, Hong-kong, and Formosa to N. Australia and Queensland, in *Malaysia*: Malay Peninsula, N. Sumatra (Toba), West Borneo, Java, and Madura, Celebes (Makassar and Tinampu), Philippines (Luzon).

Ecol. In damp, sandy places, in alang-fields, and on sandy padang soils, in Java decidedly in regions subject to a pronounced dry monsoon, in the lowland below 300 m, only on the Toba Plateau at 900 m, fl. April–Oct., Jan..

9. *Xyris lobbii* RENDLE, *J. Bot.* 37 (1899) 506, t. 403, f. 17–24; MALME, *l.c.* (1927) 390; *l.c.* (1929) 389.—Fig. 1 I.

*Leaves* ensiform, 12–40 cm by 3–6 mm, acute, sometimes subfalcate, papillate, with thickened margins; sheath 7–10 cm, slightly widened at the base. Peduncle 40–65 by *ca* 1 mm, terete, papillate. Head ellipsoid to globose, 9–12 by 7–12 mm. Basal bracts ovate,  $4\text{--}4\frac{1}{2}$  by  $2\frac{1}{2}$ –3 mm, obtuse to subtruncate, thickened and minutely papillate in a narrow triangle, 1-nerved. Median bracts obovate to elliptic, 6–8 by 4–5 mm, thickened in a narrow triangle from top to base, papillate in a narrow quadrangular field in the apical half, with *ca* 14 complete nerves. Lateral sepals 6– $6\frac{1}{2}$  mm by  $1\frac{1}{2}$ –2 mm in the upper part, tapering towards the base, obtuse, emarginate, crest fimbriate in the upper half. Median sepal unknown. *Petals* 10–12 mm

long, limb cuneate,  $2\frac{1}{2}$ –5 by  $3\frac{1}{2}$ –6 mm, margin crenulate, claw 8–9 mm long. *Stamens* 4–4½ mm, anthers 2–2½ mm, obtusely incised at the top; top and base of thecae subacute. *Staminodes* twice forked, 9–10 mm, penicillate. Ovary obovoid, 3-sided, 3-celled, ca  $2\frac{1}{2}$  by 1 mm, truncate, stipitate. Style 3-fid, 5–6 mm, branches ca 3 mm, capitate at the top.

Distr. Siam & S. Burma (*var. burmana*) and Malaysia: Malay Peninsula.

Notes. *Var. burmana* MALME is found in S. Burma and Siam and may be found in Malaysia. It differs from the type-variety in the shorter leaves, the relatively longer sheath, and the larger number of nerves in the bracts.

**10. *Xyris oreophila*** RIDLEY, J. Fed. Mal. St. Mus. 7 (1916) 121; Fl. Mal. Pen. 4 (1924) 349, f. 202; MALME, *l.c.* (1927) 391; *l.c.* (1929) 385.—Fig. 1 J.

Medium sized. *Leaves* ensiform, 7–36 cm by 1–3 mm, acuminate, papillate, mature leaves sometimes glabrous; sheath 3–7 cm long. Peduncle 20–55 cm by ca 1 mm, terete to subterete, with or without one or two ribs, densely papillate. Head ellipsoid to obovoid, 6–14 by 5–12 mm. Basal bracts obovate, 3–7 by 1–3 mm, emarginate, slightly keeled, papillate in a narrow elliptic field along the midrib, with 4 descending nerves. Median bracts spatulate to obovate, 5–8 by 2–4 mm, subnavicular, obtuse, emarginate, with 5–10 complete nerves; slightly thickened in a narrow, minutely papillated triangle in the apical part. Lateral sepals 6–7 by 1–2 mm, obtuse, emarginate, crest entire. Median sepal cap-shaped, 5 by 1–2 mm, 1-nerved. *Petals* 13–15 mm long, limb obovate, 6–7 by ca 3 mm, claw 7–8 by ½ mm. *Stamens* 11–12 mm, anthers 2–3 by ½ mm, emarginate; top and base of thecae acute, attached to the filament. *Staminodes* forked, penicillate, 1–2 mm. Ovary obovoid to fusiform, 3-sided, 3-celled, ca  $4\frac{1}{2}$  by 1 mm. Style ca 4 mm, 3-fid, branches 4–5 mm; stigma infundibuliform, papillate along the margin.

Distr. Malaysia: Malay Peninsula (Kedah Peak), 900–1300 m, fl. Dec.

Note. The bases of the anther-cells are attached to the filament and not free as is depicted by RIDLEY.

**11. *Xyris dajacensis*** VAN ROYEN, Blumea 7 (1953) 308.—Fig. 1 K.

*Leaves* linear, 5–16 cm by 1–2 mm, acute, often twisted, papillate, sometimes along the margins only; sheath 1–11 cm long, sometimes with a short ligule. Peduncle up to 60 cm by 1–1½ mm, distinctly compressed but sometimes terete in the basal part, twisted, subsclabrous in the upper part, glabrous in the lower part, provided with a few prominent ribs in the upper part. Head ovoid to ellipsoid, 3–10 by 2–7 mm. Basal bracts suborbicular, 1–3 by 2–4 mm, papillate at the top only, with 2 complete and 4 incomplete nerves. Median bracts broadly obovate to orbicular, 3–5 by  $4\frac{1}{2}$ –5½ mm, apex with a hollow papillate prominent tooth, entire or emarginate, margins entire to scarious, with 4–6, sometimes branched, complete nerves. Lateral sepals 3–4 by 1–2 mm, acute, with a few

teeth in the apical part of the crest. Median sepal ca 3 mm long, spathelliform. *Petals* 3–4 mm long, limb obovate-cuneate, 2–2½ by  $1\frac{1}{2}$ –2 mm, margin crenulate, claw ca 2 mm long. *Stamens* ca  $2\frac{2}{3}$  mm, filaments ca  $1\frac{1}{5}$  mm, abruptly narrowed at the top, anther ca  $2\frac{2}{3}$  mm, deeply incised at either end, top and base of the cells obtuse. *Staminodes* penicillate, ca ½ mm. Ovary obovoid, 3-sulcate, 3-celled, 2–3 by 1½ mm. Style 3-fid,  $2\frac{1}{2}$ –3 mm, with 2 broad membranes and a narrow wing decurrent along the ovary; stigmas leaf-like widened, united in a 3-sided infundibulum.

Distr. Malaysia: Br. N. Borneo (Sandakan, Labuan).

Notes. This species resembles *X. complanata* but differs from it by the obtuse ends of the anther-cells, the spinulose bracts, and the ribless margins of the leaf. It closely resembles *X. pauciflora* but has a larger region with minute papillae on the bracts, different anthers and leaves with thickened cells in the margins.

**12. *Xyris grandis*** RIDLEY, J. Linn. Soc. 38 (1906) 332; J. Fed. Mal. St. Mus. 2 (1911) 138; Fl. Mal. Pen. 4 (1924) 347; MALME, *l.c.* (1929) 392.—Fig. 1 L.

*Leaves* ensiform, acuminate, 50–90 by 1–2 cm, sometimes falcate, distinctly nerved, glabrous; sheath 20–30 cm long, widened and reddish brown or dark brownish at the base. Peduncle 25–60 cm by 3–4 mm, 3-sided in the upper part, subterete in the basal part. Head brown, ovoid to subglobose, 1–1¾ by ca  $1\frac{1}{2}$  cm. Basal bracts navicular, 10–22 by  $2\frac{1}{2}$ –3½ mm, obtuse, crested. Median bracts ovate-oblong, 8–13 by 3–4 mm, obtuse or emarginate, minutely spinulose, with 4 descending nerves. Lateral sepals 8–9 by ca 2 mm, obtuse, crested, entire. Median sepal spathelliform, 1-nerved, up to 5 by 4 mm. *Petals* up to 15 mm long, limb suborbicular, up to 7 by 3–4 mm, outer margin lacerate, claw 7–8 mm. *Stamens* 3–3½ mm, anthers brown, 2–2½ mm; thecae close to each other, each with 2 acute tips and obtuse base. *Staminodes* absent. Ovary ellipsoid, 2–3 by 1–1½ mm, attenuate at the base, 3-sided, 3-celled. Styles 3-fid,  $6\frac{1}{2}$ –7 mm, branches linear, 3–4½ mm.

Distr. Malaysia: Malay Peninsula (Main Range).

Ecol. In forests, swampy places and screes, 900–2200 m, fl. March–Oct.

Notes. This clearly marked species belongs with *X. chlorocephala* to the most robust representatives in Malaysia.

**13. *Xyris chlorocephala*** VAN ROYEN, Blumea 7 (1953) 308.—Fig. 1 M.

*Leaves* ensiform, acuminate, 35–65 by  $2\frac{2}{3}$ –1¾ cm, sometimes falcate, distinctly nerved, glabrous; sheath 10–20 cm long, widened and reddish brown or dark brownish at the base. Peduncle 25–65 cm by 3–4 mm, flattened immediately below the head, subterete in the lower part. Head green, 1–1½ by ca  $1\frac{1}{2}$  cm. Basal bracts navicular, 7–9 by 2–3½ mm, obtuse, crested. Median bracts ovate to squamate, 8–13 by 3–4 mm, obtuse or emarginate, minutely spinulose, with 2 twice forked descending nerves. Lateral sepals 8–9 by ca 2 mm, obtuse,

crest abruptly narrowing near the top. Median sepal spatheiform, up to 5 by 4 mm. *Petals* up to 15 mm long, limb suborbicular, up to 7 by 3-4 mm, outer margins lacerate, claw 7-8 mm long. *Stamens* 3-3½ mm, anthers 2-2½ mm, yellow, connective widened, membranous; thecae with 2 acute tips, mucronate at the base, inner cells shorter than the outer ones. *Staminodes* forked, penicillate, 2-2½ mm long, with a short mucro in the fork. Ovary ellipsoid, 2-3 by 1-1½ mm, attenuate at the base, 3-sided, 3-celled. Styles 3-fid, 6½-7 mm, branches linear, 3-4½ mm.

*Distr. Malaysia:* Central Sumatra (Westcoast, Serasah Bunta near Pajakumbu and Harau Cleft).

*Ecol.* In the spray of waterfalls and on steep damp walls with seepage water, often rooting in moss, 500 m, *fl.* March, Aug..

*Note.* Closely resembling *X. grandis* but differing in the smaller leaves, the green head, the peduncle which is flattened below the head, the absence of a minutely papillate field on the bracts, the crest of the lateral sepals which abruptly narrows at the top, the presence of penicillate staminodes, in the shorter inner loculi of the yellow anther, and the mucronate base of the anther-cells.

**14. *Xyris indica* LINNÉ, Sp. Pl. 1 (1753) 42, *pro stirp. ind. orient.*, *emend.* J. E. SMITH, in REES, Cy-**



Fig. 5. Distribution of *Xyris indica* L. var. *indica* in Malaysia.

clap. 30 (1819) *no* 11, *non sensu* PURSH, Fl. Am. Sept. (1814) 33 *quae est X. torta* J. E. SMITH, l.c.; NILSSON, l.c. 38; RENDLE, J. Bot. 37 (1899) 497; WEINZIEHER, Flora 106 (1914) 393-432, t. 6 & 7; Festschr. Inst. Allg. Bot. Univ. Zürich (1914) 43-82, t. 1 & 2; BEUMÉE, Trop. Natuur 6 (1917) 155-159, f. 1-10; BACKER, Handb. Fl. Java 3 (1924) 4; Onkruid. Suiker. (1928) 176; RIDLEY, Fl. Mal. Pen. 4 (1924) 348; MALME, l.c. (1929) 390.—*X. calcephala* MIQ. Fl. Ind. Bat. 3 (1855) 527.—*X. robusta* MART. in WALL. Cat. (1828) *no* 6087; in WALL. Pl. As. rar. 3 (1832) 30.—*X. capito* HANCE, J. Bot. 14 (1876) 262.—*X. paludosa* R. BR. Prod. 1 (1810) 256.—Fig. 1 N, 4-5.

*var. indica.*

Robust perennial. *Leaves* linear-ensiform, 5-60 by 1/3-1 cm, top falcate and curved in the mature ones, straight in the juvenile ones, acute to obtuse, glabrous, indistinctly nerved when dry, with numerous short, prominent transverse ribs connecting the nerves; sheath 8-30 cm long. Peduncle 20-80 cm by 1½-3 mm, twisted, compressed to terete, with prominent nerves. Head ovoid to subglobose or ellipsoid, 1/2-3½ by 1/2-1½ cm. *Bracts* papyraceous, concave, slightly 5-angled to obovate, 5-8 by 5-7 mm, obtuse to truncate, entire or emarginate, with membranous gold-coloured margins, with *ca* 4-6 descending nerves, minutely papillate in the upper third. *Lateral sepals* 5-7 by *ca* 1 mm, obtuse; crest dentate, sometimes entire, in the apical flowers shorter than the wings and then the apex of the sepals acute. Median sepal cap-shaped, up to 4 by 2½ mm. *Petals* yellowish to yellow, 8-10½ mm long, cuneate, limb obovate or ovate, 3½-5 by 3-4 mm, margin serrulate, claw 5-6 by 1/2 mm. *Stamens* *ca* 4 mm long; anthers 4-sided, 1½-2 by ¾ mm, top broadly incised, with a short mucro in the incision; thecae acute or mucronate at both sides, connective membranous. *Staminodes* penicillate, 2-3 mm long. Ovary obovoid, 3-sided, 2½-3 by 1½-2 mm, 1-celled. Style 3-fid, 2-3 mm long. Fruit 3-4 mm high.

*Distr.* Ceylon, India, Cochín-China, China and Hainan to Australia, in *Malaysia*: Sumatra (once



Fig. 4. *Xyris indica* L. var. *indica* in a rice-field in Krawang (West Java).

at Fort de Kock, Westcoast Res.), Java and Madura (most abundant in West Java), Philippines.

Ecol. Almost exclusively restricted to and common in inundated rice-fields, often giving at a certain stage a yellow tinge to the ripening fields, but erratically distributed and absent in adjacent fields (BACKER, Krakatao, 1929, 7, footnote), mainly below 250 m, but found at 600 m (Tjibadak, W. Java) and 900 m (Fort de Kock, W. Sumatra), both in everwet and seasonal regions, preferring the lighter soils, acc. to COERT preferring sandy soils in E. Java, *fl.* throughout the year, but mostly March-June.

Notes. As LINNÉ's description comprised two species, J. E. SMITH emended the circumscription by typifying it with the Indian element, at the same time giving a new name and a description of the American element (RENDLE, *l.c.*). A variety occurs in Indo-China.

Vern. *Djadjaruman*, *djukut pëntolan*, *latun*, *babawangan beureum*, *S*, *atjuk-atjuk*, *J*, *bunga dari kandang*, *rumpot bagau*, *jérangau padang*, Mal. Pen., *pérangan padang*, Penang.



Fig. 6. *Xyris capensis* THUNB. var. *schoenoides* (MART.) NILSS. in a swamp on Mt Patuha (West Java). Below: leaves and heads of *Eriocaulon blumei* KOERN. (DE VOOGD, 1939).

15. *Xyris capensis* THUNB. var. *schoenoides* (MART.) NILSSON, Kongl. Vet. Akad. Förh. (1891) 3, p. 154-155; NILSSON, *l.c.* (1892) 41.—*X. schoenoides* MART. in WALL. Cat. (1828) no 6083; in WALL. Plant. As. rar. 3 (1832) 30.—*X. macrocephala* (non VAHL) JUNGH. Java, ed. 2, neerl. 1 (1853) 543.—



Fig. 7. *Xyris capensis* THUNB. var. *schoenoides* (MART.) NILSS. Tuft on swinging moor of Mt Diëng (Central Java) (POLAK, 1930).

*X. melanocephala* MIQUEL, Fl. Ind. Bat. 3 (1855) 528; NILSSON, *l.c.* (1892) 42; MALME, *l.c.* (1927) 392; MALME, *l.c.* (1929) 391.—*X. sumatrana* MALME, *l.c.* (1929) 391-392.—*X. semifusca* BOJER ex BAKER, J. Linn. Soc. 20 (1884) 277.—*X. novoguineensis* HATUSIMA, Tokyo Bot. Mag. 56 (1942) 422.—Fig. 1 O, 6-9.

Leaves rigid, ensiform, 10-50 cm by 2-4 mm, top falcate, curved, obtuse; sheath 6-16 cm long, crested, ligule 2-25 mm long. Peduncle 20-96 cm by 1½-3 mm, subcompressed, ribbed, with one distinct wing, but with 2 in the upper part, twisted, basal part subvillose and sometimes shining brown.





Fig. 8. *Xyris capensis* THUNB. var. *schoenoides* (MART.) NILSS. Gregarious in the marsh Tegal Bungbrung, Mt Papandajan (W. Java), ca 2350 m alt. (DOCTERS VAN LEEUWEN, May 1930).

Head subglobose to obovoid, up to 1 cm diam. Basal bracts orbicular; median bracts narrowly elliptic and shortly spinulose, sometimes broadly boat-shaped. Bracts in either case provided with 6-9 mainly complete, sometimes incomplete nerves, 4-9 by 3-6 mm. Lateral sepals boat-shaped, 6-7 by 1-1½ mm, obtuse to acute, entire, with a narrow crest. Median sepals cap-shaped, 3-4 by ca 2 mm, obtuse. Petals yellow or yellowish, limb obovate, 4-5½ mm long, claw 6-7 mm. Stamens ca 2 mm long, filaments ca ½ mm, anthers ca 1½ by ca ½ mm, obtusely incised at the top, apex of thecae with 2 teeth, base obtuse to mucronate, connective membranously widened. Staminodes bifid, penicillate, 1½-2½ mm. Ovary 3-sided, 1-celled with 3 parietal placentas, obovoid, 4-6 by ca 2 mm. Style 3-fid, 2½-3½ mm, branches 1½-2 mm, stigmas infundibuliform, papillate.

Distr. SE. Asia and throughout Malaysia: Su-

matra (N. half), Malay Peninsula (Cameron's Highlands), Java (W.-Central), Central Celebes (Lake Posso and Limbung near Masamba), Moluccas (Buru), and New Guinea (Arfak Mts and Morobe Distr.), the species *s.l.* distributed from Central Africa to Australia.

Ecol. Mountain swamps, stream and lake banks, swinging moors, sometimes rather close to solfatara (Diëng, Gajolands), mostly associated with sedges and *Juncus*, locally often subdominant by densely set tufts, (600)-900-2500 m, fl. Jan.-Dec..

Notes. In Java on the Diëng-plateau it is sometimes used as an inferior substitute for *Fimbristylis* in the construction of mats (HEYNE, Nutt. Pl. 1927, 427).

Vern. *Mëndongan*, J, *aga mantjii*, Alahan Pandjang, *sinar uluh uluh*, Toba.

**16. *Xyris flabellata* VAN ROYEN, Blumea 7 (1953) 308.—Fig. 10.**

Small, not tufted. Leaves ensiform, 2½-9½ cm by 1½-2½ mm, equitant, acute, falcate, with a stout hollow nerve in either margin, minutely papillate; sheath 1½-7½ cm long; leaves enveloping the peduncle provided with an obtuse, 5-10 mm long acumens, but without a limb. Peduncle 8-28 cm by 1-1½ mm, subterete, provided with one stout rib, papillate. Head obovoid to ovoid, 5-7 by 3-5½ mm, few-flowered. Basal bracts black,



Fig. 9. Distribution of *Xyris capensis* THUNB. var. *schoenoides* (MART.) NILSS. in Malaysia.



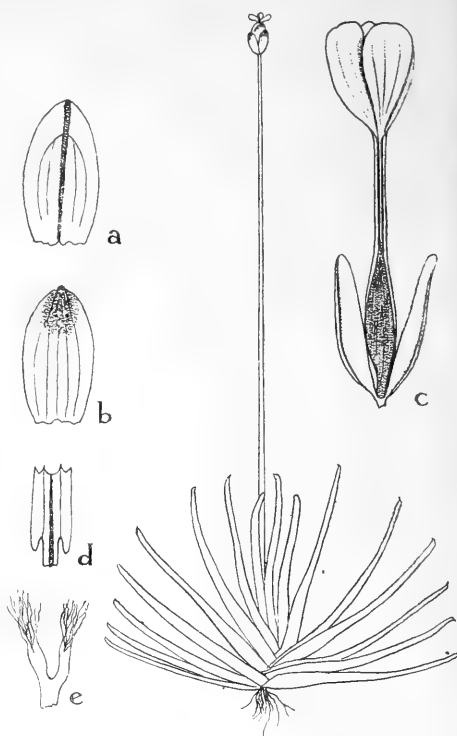
ovate, 5–6 by  $3\frac{1}{2}$ –4 mm, obtuse, distinctly crested, with 4 descending nerves. Median bracts obovate, 6–7 by  $2\frac{1}{2}$ –4 mm, crested, black and papillate in the apical part, with 5–6 complete nerves. Lateral sepals obtuse,  $5\text{--}5\frac{1}{2}$  by  $\text{ca } 1\frac{1}{2}$  mm, with an entire, narrow crest. Median sepal cap-shaped, 1-nerved,  $\text{ca } 4$  mm long. Petals 8–10 mm long, limb elliptic to orbicular,  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm long, claw  $4\frac{1}{2}$ – $5\frac{1}{2}$  mm. Stamens  $\text{ca } 2$  mm, filament  $\text{ca } 1$  mm long; anthers  $1\text{--}1\frac{1}{2}$  mm, top retuse, top of the thecae with 2 acute teeth, base mucronate, connective membranously widened. Staminodes bifid, penicillate, 1–2 mm. Ovary fusiform to obovoid, 3-sided, 3-celled,  $3\text{--}4$  by  $\frac{3}{4}$ – $1\frac{1}{2}$  mm. Style 4–5 mm, 3-fid, branches  $\text{ca } 2$  mm long, capitate.

Distr. *Malaysia*: North Sumatra (Gajo Lands).

Ecol. In marshy, low, open vegetation of mountain heaths, typified by *Cyperaceae*, *Eriocaulon*, and *Patersonia*, 2350–3300 m.

Notes. The leaves are typically equitant, forming in the field characteristic 'combs'. They are rather fleshy and have a yellowish-green colour.

Fig. 10. *Xyris flabellata* VAN ROYEN. Habit,  $\times \frac{3}{4}$ , a. basal bract, b. median bract, c. lateral sepals and flower, d. stamen, e. staminode (after VAN STEENIS 8430).



#### Excluded

*Xyris operculata* 'LABILL.'; NAVES, Nov. App. (1880) 268. According to MERRILL (En. Philip. I, 1922, 192) this is a wrong record of this Australian species for the Philippines.

## DROSERACEAE (C. G. G. J. van Steenis, Leyden)

Small terrestrial or aquatic, insectivorous herbs. Primary root often undeveloped, stembase with adventitious roots, sometimes tuberous. *Leaves* spirally arranged, often in basal rosettes, rarely whorled, provided with sessile or stipitate sticky glands, marginal glands longest, often circinate when young. Stipules mostly present. Inflorescence lateral or terminal, cymose, often circinate. Bracts absent or present. Bracteoles 0; pedicels not articulated. *Flowers* ♂, actinomorphic, (in Malaysia) 5-merous. *Sepals* imbricate, persistent, at the base  $\pm$  connate. *Petals* imbricate, free, thin, veined, marcescent, long persistent. Stamens (in Malaysia) 5, free, alternating with the petals; filaments filiform; anthers extrorse; pollen in tetrads. Disk 0. Ovary superior, free; 1-celled; carpels 3-5 with parietal placentas. Styles 3-5, mostly free, simple or divided. Ovules mostly  $\infty$ . *Capsule* mostly loculicid, 3-5-valved. *Seeds* small, mostly  $\infty$ , albuminous; embryo straight; cotyledons short.

Distr. Of the 4 genera three are monotypic: *Drosophyllum* is endemic in the West Mediterranean, *Dionaea* is endemic in Atlantic N. America, and *Aldrovanda* is found from Europe through Asia to Australia. *Drosera* is predominantly developed in the S. hemisphere, specially in Australia and though distributed almost over the globe, it is absent from many regions.

Ecol. The family shows a remarkable display of wide ecological tolerance. In Australia *Drosera* penetrates into the very dry interior but other species occur in the humid tropics, in the temperate, or in the cold zones of the globe. *Aldrovanda* is aquatic. In Malaysia some *spp.* of *Drosera* are apparently bound to a seasonal climate (*D. indica*, *D. peltata*, and *D. petiolaris*), others are restricted to a everwet climate (*D. burmanni* & *D. spathulata*). *Droseras* distinctly prefer sandy or otherwise acid, mostly poor, oligotrophic soils.

Notwithstanding this plasticity in tolerance for the genus as a whole, collections of individual species are in Malaysia comparatively few and suitable conditions are apparently scarce even for widely distributed species. Moreover, specimens easily escape attention of collectors by their small size. Collectors are invited to make notes of the colour and structure of the flowers (specially the gynaecium) on the spot facilitating later identification.

The trapping of small insects is in *Drosera* achieved by the sticky stalked glands of the leaf blades, and their protein substances are digested by the exuded juice.

In *Aldrovanda* a more specialized trapping mechanism is developed for catching crustaceans, diatoms, &c., the functioning of which has recently been reinvestigated by J. ASHIDA (Mem. Coll. Sc. Kyoto Imp. Univ. B, 9, 1934, 141-244). Sensitive hairs occur on the thickened inner portion of each leaf half. Through touch or other irritation the leaf halves move with the midrib as axis and are pressed against each other in a fraction of a second, by which movement the incurved margins close the leaf blade which is then transformed into a bladder-like organ. This motion is immediately followed by a second pressure shutting the bladder still closer. Cf. fig. 7. Digestion takes place in the bladder by protein-digesting substances emitted by glands, slowly disintegrating trapped things.

### KEY TO THE GENERA

1. Terrestrial. Leaves spirally arranged, often condensed into basal rosettes. Leaf blade not articulated, provided with sticky capitate glands (tentacles). Petioles not connate. Flowers rarely solitary. **1. *Drosera***
1. Submerged aquatic. Leaves in whorls. Leaf blade articulated, without such glands. Petioles connate at the base. Flowers axillary, solitary . . . . . **2. *Aldrovanda***

### 1. DROSEREA

LINNÉ, Sp. Pl. (1753) 281; Gen. Pl. ed. 5 (1862) no 391; DIELS, Pfl. Reich Heft 26 (1906) 61.—Fig. 1-5, 7.

Mostly perennial, often stemless, often with a subterranean tuber. *Leaves* with glandular, irritable, capitate tentacles. Stipules present or absent, often split. *Flowers* in simple (or branched), bracteate inflorescences (in extra-Mal. *spp.* sometimes solitary), white, pink, or purple, 5(-4)-merous. *Sepals* imbricate, connate at the base. *Petals* in Mal. *spp.* 5, spatulate or obovate, marcescent, after

anthesis contracted and sticking together with the anthers and stigmas as a hood over the ovary and the capsule. *Carpels* 3–5; *styles* 3–5, free or connate at the base, often divided in various ways.

Distr. *Ca* 90 spp., nearly throughout the world, centering in the S. hemisphere, specially in extra-tropical Australia, absent from large areas in S. Asia, the Near East, the N. & E. parts of Africa and the W. parts of S. America.

Ecol. See under the family description.

Uses. Among the Igorots the leaves of *D. peltata* are dried and powdered and the powder is placed into the cavity of an aching tooth (QUISUMBING 1951). From Billiton TEYSMANN (Nat. Tijd. N.I. 36, 1876, 223) reported that *D. burmanni* should break up teeth. Acc. to BURKILL (Dict. 1935) Chinese import *Drosera* into the Malay Peninsula for use in pharmacies, but it is unknown for what specific purpose.

Vern. *Zonnedauw*, *D. sundew*, *E.* The name is derived from the fact that the leaf glands excrete so much juice that the plants seem covered with dew drops. This holds for the Malaysian species.

#### KEY TO THE SPECIES

1. Leaves in a basal rosette, with stipules.
2. Styles and carpels 5. Leaves nearly sessile, obovate to orbicular . . . . . 1. *D. burmanni*
2. Styles and carpels 3, styles sometimes divided from near the base. Leaves petioled.
3. Style-arms 2–4 times forked. Sepals outside fulvous-lanuginose. Petiole contracted at the apex; blade orbicular, concave. Stipules not prominent, entire or the upper half split into subulate segments . . . . . 2. *D. petiolaris*
3. Style-arms split near the base into 2 filiform arms. Sepals glandular outside, glabrous. Petiole broadened towards the apex into a flat, obovate-spathulate blade. Stipules conspicuous, rufous, 3-fid . . . . . 3. *D. spathulata*
1. Leaves cauline, without stipules.
4. Leaves linear. Petiole indistinct. Stem without subterranean tuber. Styles 3, forked at the base into 2 thickened, ascendent arms . . . . . 4. *D. indica*
4. Leaves semi-orbicular, peltate, at the base with 2 caudate, fimbriate elongations. Petiole distinct. Stem originating from a subterranean tuber. Styles 3, towards the apex brush-shaped divided. . . . . 5. *D. peltata*



Fig. 1. *Drosera indica* L. (left) and *Drosera burmanni* VAHL (right), both  $\times \frac{1}{2}$  (after resp. BACKER 20136 from the Island of Madura and BOUMAN-HOUTMAN 80 from Celebes).

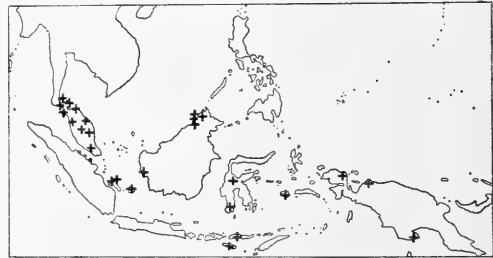


Fig. 2. Distribution in Malaysia of *Drosera burmanni* VAHL.

Rosulate. Leaves red or green, appressed to the soil, obovate to orbicular; blade 6–10 by 4–6 mm. Stipules mostly 3-parted, each segment with lanceolate acute lobes. Peduncles 1–3, erect, 4–27 cm, rhachis 1–9 $\frac{1}{2}$  cm, 2–25-flowered. Pedicels erect, 1 $\frac{1}{2}$ –4 mm. Sepals oblong, blunt, 2 $\frac{1}{2}$ –3 mm long. Petals white, obovate, ca 4 mm long. Styles 5, at

their apex split into very short lobes. *Capsule* ca 1½ mm long. *Seeds* dark, very fine-scribbulate.

Distr. India to S. Japan, Micronesia (Palau) and NE. Australia, throughout *Malaysia* but not yet found in Sumatra and Java. Fig. 2.

Ecol. On open sandy or peaty soils, mostly between grass, often not far from the sea, in many islands very local, apparently under everwet climatic conditions, 2-900(-1400) m. *Fl. fr.* Jan.-March. Highest locality is in M. Celebes (Mamasa).

Vern. *Punggu api*, Billiton, W. Borneo, *serenta bumi*, Karimata.

2. *Drosera petiolaris* R.Br. in DC. Prod. 1 (1824) 318; F.v.M. Descr. Not. Pap. Pl. 9 (1890) 54; DIELS, Pfl. Reich Heft 26 (1906) 102, f. 33 A-D; STEEN. Bull. Jard. Bot. Btzig III, 13 (1933) 107; J. Arn. Arb. 28 (1947) 420.—Fig. 5, 7h.

Rosulate. *Leaves* appressed to the soil. Petiole narrow-lanceolate, sometimes subterete, sericeous, narrowed towards both ends, constricted below the blade, 1½-2½ (-5) cm; blade orbicular, 2-2½ mm, margin with capitate fimbriae. Stipules not prominent, scarious, unnerved, narrow, entire or split into subulate segments, 8-10 by ¾-1 mm. *Inflorescences* densely hairy, peduncle glabrescent. Peduncles 1-2, ascending, 5-12(-30) cm, pedicels short, recurved after anthesis, 10-35-flowered. *Sepals* obovate to subspathulate, inside glabrous, 2½-4 by 1½-4 mm. *Petals* pink to purple, broad-ovate, 7 by 5-5½ mm. Stamens 2½-3 mm long; filaments terete. Styles 3, base forked, apex of each arm with short, repeatedly forked clavate segments. *Seeds* ellipsoid, shortly mamillate.

Distr. N. Australia, in *Malaysia*: SE. New Guinea (Wassi Kussa). Fig. 5.

Ecol. Periodically wet savannah areas under periodically dry climatic conditions at low altitude, acc. to BRASS one of the first herbs to flower on wet sandy flats near Tarara in Dec. 1936.

3. *Drosera spathulata* LABILL. Nov. Holl. Pl.Sp. 1 (1804) 79, t. 106, f. 1; MIQ. Fl. Ind. Bat. 1, 2 (1858) 120; Bot. Mag. 87 (1861) t. 5240; DIELS, Pfl. Reich Heft 26 (1906) 83, f. 31 A-B; MERR. En. Philip. 2 (1923) 216; STEEN. Bull. Jard. Bot. Btzig III, 13 (1933) 108; J. Arn. Arb. 28 (1947) 420.—Fig. 3, 7g.

Rosulate. *Leaves* appressed to the soil. Petiole ca 8-10 mm, glabrous at the base; fimbriate towards the apex; blade ca 5 mm diam., often spathulately widening towards the 5 mm large, obovate to spathulate blade. Stipules membranous, rufous, ca 5-7 mm long, mostly 3-fid, segments unequal, ending in a bristle. *Peduncles* 1-2, ascending, 1-20 cm, towards the apex often glandular-pubescent, 1-15-flowered. Pedicels short, erect, ½-3 mm. *Petals* obovate, cuneate at the base, white or pink, 3½-6 mm long. Stamens 2½-3 mm long. Styles 3, ca 2½ mm long, bifurcate from the base, arms simple, ascending, curved, incrassate towards the base. *Seeds* minute, ellipsoid, dark, very fine granular.

Distr. S. Japan, China, and Formosa to E. Australia, Tasmania, and New Zealand, in *Ma-*

*laysia*: N. Sumatra (Gajo Lands), Mal. Peninsula, Br. N. Borneo (Kinabalu), the Philippines (Luzon, Mindoro), and SE. New Guinea (Tarara). Fig. 3.

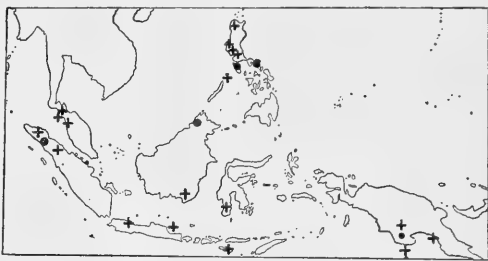


Fig. 3. Distribution in *Malaysia* of *Drosera indica* L. (+) and *Drosera spathulata* LABILL. (•).

Ecol. Open mountain heaths, on Mt Kinabalu on damp serpentine rocks, in the Gajo Lands on damp sandy or clayey soils between sedges, under everwet climatic conditions, rarely on wet ground in savannah forest at low altitude, (10-)1200-2800 m. *Fl. fr.* Jan.-March.

Notes. The Sumatran and Philippine specimens differ slightly from those of Mt Kinabalu by obovate, not acute petals with slight crenulations towards the apex, by broader bracts, and by a scarcely capitate-glandular inflorescence. The style-arms are sometimes halfway forked for a second time.

4. *Drosera indica* LINNÉ, Sp.Pl. (1753) 282; MIQ. Fl. Ind. Bat. 1, 2 (1858) 120; F.v.M. Descr. Not. Pap. Pl. 6 (1885) 4; KING, J. As. Soc. Beng. 66, ii (1897) 306; *ibid.* 71, ii (1902) 48; DIELS, Pfl. Reich Heft 26 (1906) 77, f. 29; RIDL. Fl. Mal. Pen. 1 (1922) 688; MERR. En. Philip. 2 (1923) 216; BACKER, Onkr. Suiker. (1930) 257; STEEN. Bull. Jard. Bot. Btzig III, 13 (1933) 108; BACKER, Bekn. Fl. Java, em. ed. 4 (1942) fam. 53; STEEN. J. Arn. Arb. 28 (1947) 420; HENDERSON, Mal. Nat. J. 4 (1949) 107.—*D. hexagynia* BLANCO, Fl. Filip. (1837) 226 (*hexagynia*).—Fig. 1, 3, 7f.

Stem flexile, slightly compressed, short glandular-hairy, 5-30 cm. Lower *leaves* recurved, often as stiltroots supporting the stem, central leaves spreading, upper ones erect, linear, light-green, petiole 1-15 mm; blade with tentacles, 2-11 cm by ½-3 mm. Stipules absent. *Inflorescences* lateral, mostly extra-axillary, spreading or arching, glandular-hairy, 3-20-flowered; peduncle ½-5½ cm; rhachis 3-15 cm. Bracts minute, linear. Pedicels ¾ cm, in fruit to 2 cm long. *Sepals* lanceolate, acute, 3-5 mm long. *Petals* obovate, ¾-1 cm long, pink to pale-purple. Anthers hastate. Styles 3, from the base divided into 2 thickened, simple ascendent arms. *Capsule* broadly oblong, *Seeds* apiculate, nigrescent, scribbulate.

Distr. Trop. Africa and Ceylon to Japan and Australia, in *Malaysia*: not yet found in the Moluccas, in many other islands very scarce. Fig. 3.

Ecol. In periodically wet grasslands, on mud, fallow rice-fields, in Indramaju on bog-iron asso-

ciated with *Fimbristylis dallachyi* F.v.M., locally sometimes abundant, in Java restricted to the regions with a distinct dry monsoon, 10–900 m. *Fl.* Febr.–April (Java), Sept. (N.G.).

Vern. *Bintipálo*, Tag.

Note. White-flowered specimens have hitherto not been collected in Malaysia.

**5. *Drosera peltata*** J. E. SMITH, in WILLD. *Sp. Pl.* 1 (1797) 1546; KURZ, *J. As. Soc. Beng.* 45, ii (1876) 310; KING, *J. As. Soc. Beng.* 71, ii (1902) 48; DIELS, *Pfl. Reich Heft* 26 (1906) 110; BACKER, *Schoolfl. Java* (1911) 474; MERR. *En. Philip.* 2 (1923) 216; STEEN. *Bull. Jard. Bot. Btzig III*, 13 (1933) 108; BACKER, *Bekn. Fl. Java*, em. ed. 4 (1942) fam. 53.—*D. lunata* BUCH. HAM. in DC.

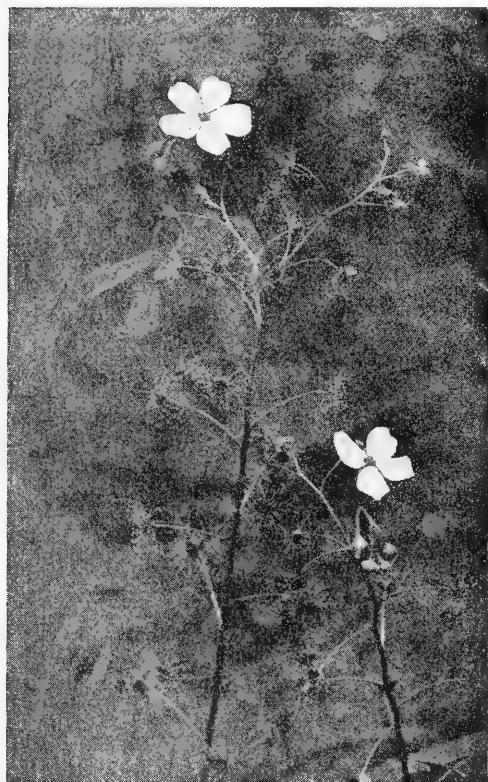


Fig. 4. *Drosera peltata* J.E.SM. Island of Sumba (DE VOOGD).

*Prod.* 1 (1824) 319; *Miq. Fl. Ind. Bat.* 1, 2 (1858) 120; FORBES, *Wand.* (1885) 422.—*D. lobbiana* TURCZ. *Bull. Soc. Nat. Mosc.* 27<sup>2</sup> (1854) 343.—**Fig. 4-5.**

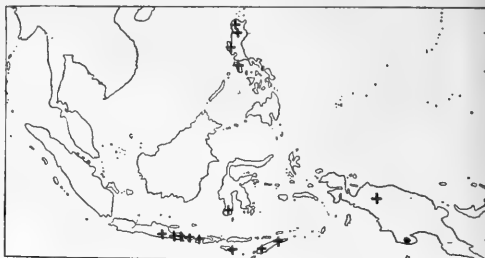


Fig. 5. Distribution in Malaysia of *Drosera peltata* J.E.SM. (+) and *Drosera petiolaris* R.BR. (•).

Stem erect, originating from a small roundish subterranean tuber, thin, glabrous, simple or branched, 10–35 cm. Basal leaves rosulate, or reduced, rapidly vanishing. Petiole distinct,  $\frac{1}{2}$ – $1\frac{1}{2}$  cm long, spreading or recurved; blade peltate, with long tentacles, semilunar with elongated angles, 2–6 mm. Inflorescences opposite to or laterally of the leaves, unbranched, 2–10-flowered. Peduncle 1–3 cm, rhachis  $\frac{1}{2}$ – $4\frac{1}{2}$  cm. Bracts linear, pedicels erect,  $\frac{1}{2}$ –2 cm. Sepals ovate to elliptic, glabrous, with fimbriate margin, 2–3 by  $1\frac{1}{2}$  mm. Petals white, spatulate-obovate, 5–6 by 2–3 mm. Stamens  $2\frac{1}{2}$ –3 mm long. Styles 3, their upper half several times forked, digitately branched, brush-shaped. Seeds ovoid, oblong, black, minutely costulate.

Distr. Ceylon SE. Asia, China, and Japan, to Australia and Tasmania, in Malaysia: East Java (Mts Idjen, Wilis, and Tengger), Lesser Sunda Islands (Bali, Lombok, Timor), S. Celebes, Philippines (Luzon), and New Guinea. Fig. 5.

Ecol. Grassy places, old lavastreams, open grassy slopes in thin pine and *Casuarina* forests, along road-sides as a krennophyte, on heaths, or on wet peaty soils containing a good deal of sand (Lake Habbema, acc. to BRASS), except in the Papuan localities mostly restricted to regions with a pronounced dry monsoon, 800–2400(–3225) m. *Fl. fr.* Dec.–June, in Luzon May–July, at Lake Habbema in Aug., on Mt Giluwe in May.

Vern. *Bain, ruut, sanabúgan*, Ig., *gumgumayéng*, Bon.

Note. KING's record for the Malay Peninsula is wrong; it was probably based on the assumption that *D. lobbiana* had been found in the Peninsula; its type came from Moulmein.

## 2. ALDROVANDA

LINNÉ, *Sp. Pl.* (1753) 281; *Gen. Pl.* ed. 5 (1862) no 390; DIELS, *Pfl. Reich Heft* 26 (1906) 59.—**Fig. 6-7.**

Rootless, submersed, floating aquatic plant, with simple or seemingly forked stem. Leaves in whorls of 7–9, connate at the base. Blade articulated, upper surface irritable by hairs and provided with glands; petiole swollen, lacunose, the apex

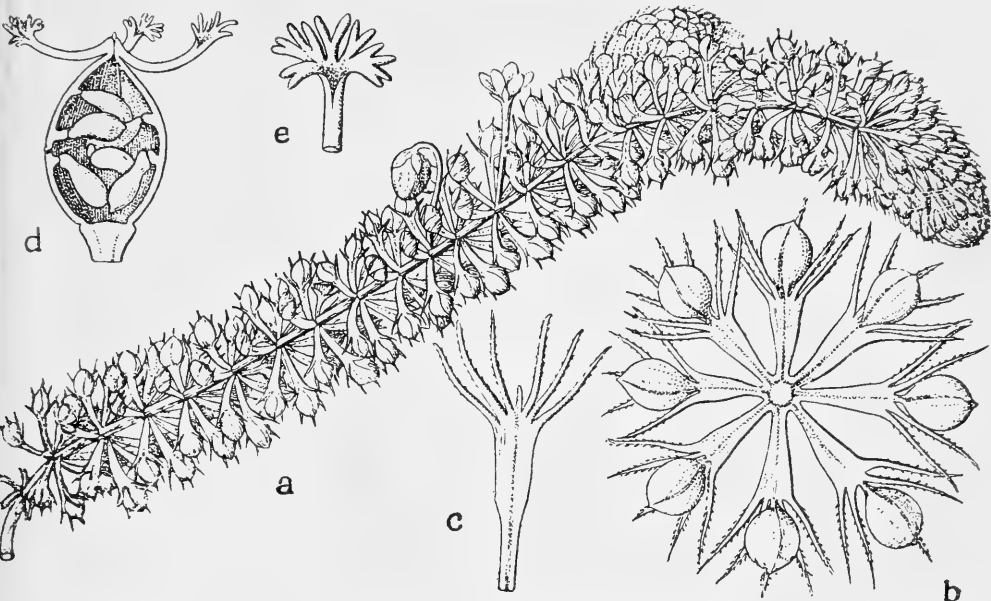


Fig. 6. *Aldrovanda vesiculosa* L. a. Plant, nat. size, b. leaf whorl, blades closed,  $\times 2$ , c. reduced leaf from flowering whorl without blade,  $\times 3$ , d. gynaecium, in section, e. style apex with stigma (after DIELS).

bearing subulate dentate segments; blade reniform to orbicular when flattened, reduced in the flowering whorl and sometimes the foregoing one. *Flowers* solitary, axillary. Pedicels robust, reflexed in fruit. *Sepals* 5, imbricate, coherent at the base. *Petals* white, originally calypttrate connivent. Styles 5, filiform, patent, incurved, apex dilitate and penicillate. *Capsule* 5-valved.

Distr. Monotypic, Europe and Asia to Queensland, with many gaps, in *Malaysia* once found in Timor.

Ecol. See under the family description.

1. *Aldrovanda vesiculosa* LINNÉ, *l.c.*; DIELS, *l.c.*; STEEN. Bull. Jard. Bot. Btzg III, 13 (1933) 109; Trop. Natuur 24 (1935) 64-68; v. MALM in FEDDE, Rep. 41 (1937) 295.—Fig. 6-7.

Stem up to 20 cm. Petiole 3-9 mm, apical subulate segments (1-3)-4-6, 6-8 mm long; flattened blade 4-7 by  $4\frac{1}{2}$ -10 mm. *Flowers* few; pedicels slightly curved, 1-1½ cm. *Sepals* ovate-elliptic, to elliptic-oblong, 3-4 by 1½ mm. *Petals* narrow-obovate, 4-5 by 2½ mm. Filaments subulate, 3-4 mm; anthers broad. Ovary and capsule subglobose. *Seeds* mostly 6-8, rarely few, abbreviate-ovoid, black, 1½ by 1 mm.

Distr. Central Europe, Caucasus, SE. & E. Asia, to Queensland, in *Malaysia*: Lesser Sunda Islands (Port. Timor: Nikki Nikki Supul swamp), once found.

Ecol. Clear, shallow stagnant water apparently poor in lime and rich in organic substance, in Bengal not avoiding brackish water, at low altitude.

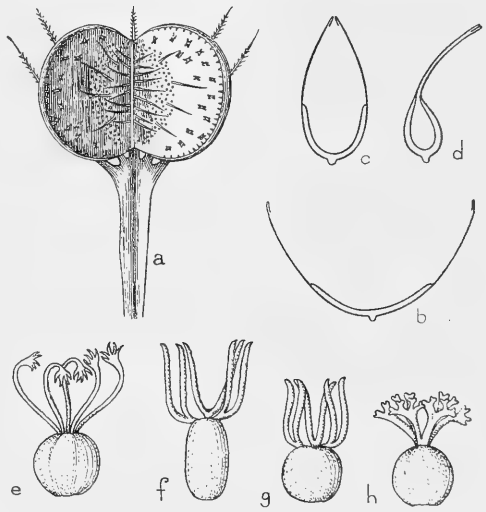


Fig. 7. *Aldrovanda vesiculosa* L. a. Open leaf blade from above, b. ditto, in section, c. ditto, first stage of closing, d. ditto, final stage. e-f. Gynaecium of *Drosera*, viz of e. *D. burmanni* VAHL, f. *D. indica* L., g. *D. spatulata* LABILL., h. *D. petiolaris* R.Br., all  $\times \frac{6}{1}$  (after ASHIDA, and DIELS).

## DATISCACEAE (C. G. G. J. van Steenis, Leyden)

Dioecious trees (or tall herbs), often lepidote or hairy. *Leaves* large, simple, entire or dentate, spirally arranged, palminerved (or compound), often asymmetric. Stipules 0. *Flowers* actinomorphic, valvate, unisexual, rarely polygamous, in elongate, bracteate, caducous spikes or panicles.—♂ *Flowers*: sepals 4-9, free and very unequal or connate in a lobed tube, isomerous, in ♂ *Tetrameles* with a few occasionally additional lobules. Petals free, isomerous or 0. Stamens isomerous and episepalous, filaments often long; anthers basifix, intrors or latrors, incurved in bud. Rudimentary ovary present or 0.—♀ *Flowers*: sepals connate above the ovary or free. Petals and rudimentary stamens 0. Styles isomerous, opposite the calyx lobes, mostly inserted on the margin of the calyx, (2-fid, filiform), club-shaped, or with a capitate stigma. Ovary inferior, 1-celled, with 3-8 parietal, alternisepalous placentas. Ovules ∞. *Capsule* opening at the apex with slits or splitting laterally; pericarp membranous. Seeds ∞, very small, ovate or spindle-shaped; testa punctate or scrobiculate, outer sheet loosely covering the embryo. Albumen 0. Embryo straight, cylindric.

Distr. Three genera with 4 spp., *Datisca* (herbaceous) with one sp. in Asia and one in W. Central America, *Tetrameles* and *Octomeles* both with one Indomalaysian sp..

Ecol. Rain forest (*Octomeles*) and monsoon forest (*Tetrameles*) below ± 1000 m.

Uses. Mainly for timber; see under the spp..

Wood anat. DEN BERGER, Med. Proefstat. Boschwezen 13 (1926) 133; DEN BERGER, Determinatietabel Houtsoorten van Malesië, Wageningen (1949) (hand lens). *Tetrameles*: MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 631; PEARSON & BROWN, Comm. Timb. 2 (1932) 606; DESCH, Mal. For. Rec. 15<sup>1</sup> (1941) 94. *Octomeles*: REYES, Philip. Dept Agric. Techn. Bull. 7 (1938) 340.

Notes. There is no unanimous opinion on the systematic position of the family which has been compared with several others cf. GILG, Pfl. Fam. ed. 2, 21 (1925) 545 and ERDTMAN, Pollen Morph. & Plant Tax. (1952) 144.

### KEY TO THE GENERA

1. Evergreen. Leaves lepidote. Petiole 5-angled. Spikes solitary, axillary. ♂ Flowers 6-8-merous. Petals present. Capsules dehiscent laterally . . . . . 1. *Octomeles*
1. Deciduous. Leaves hairy. Petiole terete. Inflorescences clustered at the apex of defoliate twigs. ♂ Flowers 4-5-merous. Petals absent. Capsule dehiscent apically. . . . . 2. *Tetrameles*

### 1. OCTOMELES

MIQUEL, Fl. Ind. Bat. Suppl. (1861) 133, 336; GILG, Pfl. Fam. ed. 2, 21 (1925) 546.—Fig. 1-4.

Colossal, fast-growing, buttressed tree with thick twigs sharply 3-angular at the apex. Flush and inflorescences lepidote, glabrescent. *Leaves* roundish-cordate, 5-7(-9)-nerved, lower surface with groups of large pitted domatial glands in the axils of the nerves, and very numerous smaller ones on the veins. Petiole long, 5-angled. *Flowers* sessile, coarse, green, 5-8-merous, thick, spreading, in axillary, sessile or peduncled spikes.—♂ *Flowers* campanulate; sepals triangular; petals triangular, with a subulate acumen; stamens in bud strongly incurved, with a thick filament and a large kidney-shaped curved intrors anther.—♀ *Flowers*: apex of the ovary deeply cup-shaped by the thick calyx tube; styles 5-8, inserted in the throat opposite the acute-triangular calyx-lobes, short, thick, applanate, crowned by a thick, capitate stigma. Petals 0. *Capsule* barrel-shaped, throwing off the irregular-longitudinally torn exocarp + calyx; endocarp pale, horny, obovate, splitting from the top downwards; persistent. Seeds spindle-shaped, produced in immense quantities.

Distr. Monotypic, Melanesia and *Malaysia*: absent from Java and the Lesser Sunda Islands. Fig. 2. Ecol. Rain forest, often alluvial and riverine, up to  $\pm 800$  m.

Notes. The generic name has sometimes been wrongly spelt *Octomelis*.

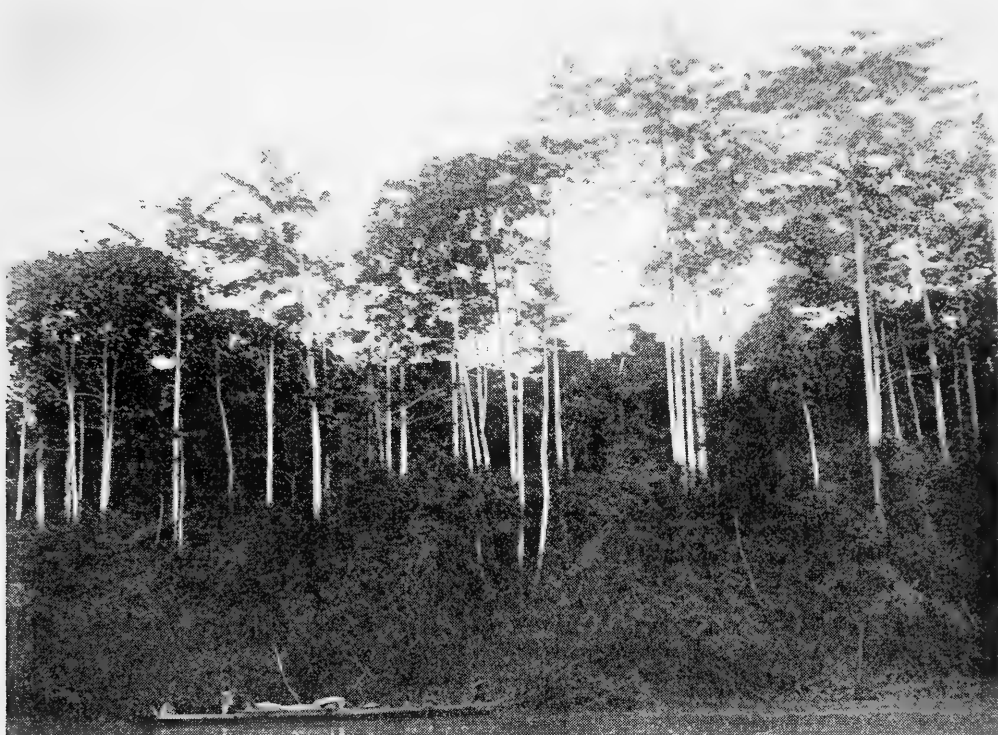


Fig. 1. Young riverine forest on the low banks of the Lower Telen (E. Borneo), of *Octomeles sumatrana* MIQ. and *Nauclea*, over a shrub layer of *Leea* (ENDERT, 1925).

1. *Octomeles sumatranum* MIQUEL, *l.c.*; BECC. Wand. (1904) 84; MERR. Int. Rumph. (1917) 378; HALL. *f. Med. Rijksherb. no 37* (1918) 5; LANE-POOLE, *For. Res. Papua* (1925) 7-8, 121, f. 3, 5, 6; GILG, *l.c.*; WITKAMP, *Tijd. K.N.A.G.* 46 (1929) 210; STEUP, *Tect.* 23 (1930) 871; *ibid.* 26 (1933) 29; KOOPMAN & VERHOEF, *ibid.* 31 (1938) 777-785, f. 1-3; SALVERDA, *Rapp. Orient. Expl.* (1937) 83; VAN DIJK, *Boschbedrijf, etc.* (1939) 20, 33, 46; WHITE, *J. Arn. Arb.* 31 (1950) 99.—*Palacca*, Rumph. *Herb. Amb.* 3 (1743) 195, t. 125.—*O. moluccana* T. & B. *ex* HASSK. in *Abh. Naturf. Ges. Halle* 9 (1866) 208; WARB. *Bot. Jahrb.* 13 (1891) 385; KOORD. Minah. (1898) 486; HALL. *f. l.c.* (1918) 6.—Fig. 1-3.

Up to 62(-80?) by  $1\frac{1}{2}$ -2 $\frac{1}{4}$  (-4?) m; clear bole up to 30 m, crown semi-globular, branching made about in pagoda habit; bark grey, thin,  $\frac{1}{2}$ -5 mm diam.; heartwood absent; wood soft, light (SG 0.34). Buttresses up to 5-10(-15?) by 6 m. *Leaf blade* 12-30 by 6-23 cm, those of young trees and suckers much larger, margin in juvenile specimens sometimes with a few coarse teeth;

nerves rufous, tertiary nerves crossbar-like; petiole 6-30 cm. ♂ *Spikes* 20-60 cm. Bracts lanceolate, acute, 2 mm long.—♂ *Flowers* 4-5 by 5 mm, lobes ovate-triangular, acute, 2 mm long. Petals trian-

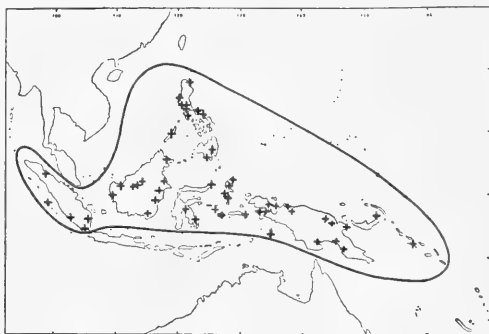


Fig. 2. Distribution of *Octomeles sumatrana* MIQ.



gular, 3 mm long, apex thickened, with an incurved subulate appendage forming a descending column in bud. Stamens ca 4 mm, filament thick, anther 2 mm.—♀ Flowers in 8–12 cm long spikes, ca 5 mm long; ovary 1–2 mm high, free calyx tube 2–4 mm high, lobes broadly triangular, ca 1 by 2 mm. Styles 1–2 mm, fleshy, thick, flattened; stigma  $\frac{1}{2}$  mm high, over 1 mm diam. Fruiting spikes 15–40 cm long, on 10–20 cm long peduncles. Capsule 12 mm long, endocarp splitting from the apex nearly to the base, ca 1 cm long. Seeds ca 1 by  $\frac{1}{4}$  mm, weighing ca 0.00005 Gr.

Distr. *Malaysia*: not yet found in the Malay Peninsula, Java, and the Lesser Sunda Islands. Fig. 2.

Ecol. Rain-forest tree, specially common along rivers, up to  $\pm$  800 m. Acc. to many explorers (BECCARI, *l.c.*) it is not a genuine constituent of the stable primary rain forest, but more a typical representative of natural secondary and seral riverine alluvial forest, often occurring in gregarious even-aged stands. KOOPMAN & VERHOEF (1938, *l.c.*) summarized ecological and silvicultural data. They state a 4 years old specimen cultivated at Bogor to have attained a height of 25 m and a diameter at breast height of 47 cm, which shows its very fast growth. They state further that *Octomeles* is not sensitive to fire. Germination power of collected seeds soon decreases. The size of mature trees is colossal: STEUP (KOOPMAN & VERHOEF, *l.c.* 780) found in Celebes the cubic content of one large tree to be 95.2 m<sup>3</sup>. Acc. to ENDERT (1927, *l.c.*) *benuwai* is a dominant tree of low moist soils in Kutei (E. Borneo), where acc. to WITKAMP (1929, *l.c.*) there are large complexes where it is absolutely dominant in the upper canopy, specially on the reed-grown capes of the big lowland rivers *e.g.* the Djambajan River. Fig. 1.

LANE-POOLE (1925, *l.c.*) found *ilimo* near Vanapa, Veimaui, Aroa, Kumusi and all the rivers of the Buna District and the foothills of the Hydrographers Range, but nowhere socially in the Mandated Territory. He says: 'it occurs scattered in rain forest in damp places, and in pure stands along banks of the big waterways. Wherever a large river like the Vanapa or the Brown has deposited a mass of alluvium, and made new ground, it comes up in a dense mass. These patches of young trees are very conspicuous, not only because they grow to the exclusion of all other trees but because they are even-aged. The tree is very attractive with its symmetrical development of branches and large, drooping leaves. Few of these *ilimo* groups reach maturity, as the rivers are continually changing their course and floods may sweep the seedling *ilimos* down to the sea. If *ilimo* has succeeded in establishing itself and growing for a generation it stands a good chance for reaching maturity. It binds the ground together with a network of roots and it takes a very great flood indeed to tear the soil away. Only an entire alteration in the course of the river can destroy the young trees now. When *ilimo* was quite young the ground was covered

by rushes<sup>1</sup> but is now covered much the same as in rain-forests; some third storey trees have found their way in, but are not numerous. Creepers, lianas and epiphytes are scarce. One 2nd storey



Fig. 3. Tree habit of *Octomeles sumatrana* MIQ. in the Botanic Gardens, Bogor; note the size to be estimated by person at base and large superficial root system (J. C. KONINGSBERGER).

(1) I assume it seeds in the *Saccharum spontaneum* fringe.

tree, *Vitex cofassus*, is found here and there. The top storey remains pure *ilimo*. In a 3.2 ha patch of over-mature *ilimo* forest were only 10 *spp.* and in all 62 individual trees, 39 (= 64%) of which were *ilimo*, furnishing 83% of the cubic content. Next in number was *Dracontomelum*, 12 trees (= 19%) with 6% of cub. content. The others were *Pometia pinnata*, *Planchonia timoriensis*, *Pterocarpus indica*, *Pterocymbium*, *Garuga*, and *Terminalia catappoides*.

'The natural succession to these even-aged stands is mixed lowland rain-forest, which will have scattered *ilimo* in it, but *ilimo* cannot again regenerate as a pure stand until the forest is destroyed. It depends for that on fresh alluvial soil which must be drained up to allow *ilimo* to spring up.' A typical seral tree, following low vegetation and preceding mixed lowland rain forest.

Uses. The wood is soft, coarse-textured and

brittle, but the timber can only be used under cover where a weak, perishable timber will suffice. The colossal stems are, however, suitable for making large canoes. The timber industry is still interested in it (*cf.* Mal. For. 14, 1951, 229). In Borneo *Octomeles* represents one of the lofty 'bee-trees'.

Vern. *Bénuang*, M, *bunung*, SE. Borneo, *dut*, *maréndai*, Kutei, *binuang*, N. Borneo, *bénua motutu*, Malili, *bénui*, *bonui*, *wénoang*, *mapopo*, *winuang*, *binuang*, *winong*, *koror*, Minahassa, *salawaku*, *dadatoko*, Morotai, *kapu*, *lipé*, *lipé weda*, *dadatoko*, Halmaheira, *afu*, *kafu*, Ternate, *ngafi*, *palaka*, Ambon, *bada*, Buru, *aitina*, W. New Guinea; Philippines: *banuang*, Sul., *barong*, *sarrat*, Ibn., *barousan*, *bilua*, *binowang*, *barausan*, *kabal*, *libas*, Tag., *Tag.*, *biluang*, Bik., Tag., Tagb., Mbo., Bagi; *erima*, trade name in New Guinea, *ilimo*, Papua, *starka*, Manokwari.

## 2. TETrameLES

R. BROWN, in *Observ. Pl. DENHAM & CLAPPERTON* (1826) 230, app. 25, *nomen seminudum*; & BENN. *Pl. Jav. Rar.* (1838) 79, t. 17; GILG, *Pfl. Fam. ed. 2*, 21 (1925) 545.—**Fig. 4-6.**

Deciduous, buttressed tree. Leaf scars prominent, conspicuous. *Leaves* roundish, acuminate, entire or dentate, undersurface densely hairy by bulbous-based simple hairs, upper surface subglabrous or sparsely set with simple hairs. *Flowers* of both sexes subsessile or shortly pedicelled, in fasciculate apical, peduncled, pendent, simple or little branched spikes (♀) or panicles (♂) with tomentose rachis on the apex of thick defoliate twigs, solitary or in twos or threes, 4-(♂) or 4-5-merous (♀).—♂ *Flowers*: calyx tube short, lobes oblong to ovate, equal, or unequal, sometimes alternating with a few occasional smaller, narrower appendages in structure similar to the calyx lobes. Petals 0. Stamens 4, opposite the sepals, inserted on the margin of the cup-shaped receptacle. Filaments short or rather long, anthers incurved in bud, 2-celled, extrors ± basifix, at last seemingly peltate. Rudimentary ovary disk-shaped, cross-like, or 0.—♀ *Flowers*: lower part of the calyx connate with the ovary, slightly 4-angular, glandular, and mostly hairy, upper part cupular, with 4 triangular lobes. Petals and androecium 0. Styles 4-5, erect, opposite the calyx lobes, inserted on the margin of the calyx throat, thickish, persistent, with an obliquely inserted, unilaterally stigmatic, thickened apex. Ovary with 4-5 parietal placentas alternating with the styles. Ovules in several rows. Flat top of the *capsule* splitting before the styles, the thus formed 4 triangular valves marcescent and curving inwards, leaving a roundish apical pore. Seeds narrow-oblong, slightly flattened.

Distr. Monotypic, SE. Asia through *Malaysia* to New Guinea. Fig. 6.

Ecol. Regions with a more or less well pronounced dry season at low altitude.

Uses. See under the *spp.*

1. *Tetrameles nudiflora* R. BROWN, in BENN. *Pl. Jav. Rar.* (1838) 79, t. 17; BEDD. *Fl. Sylv.* 2 (1869) t. 212; CLARKE, in HOOK. *f. Fl. Br. Ind.* 2 (1879) 657; KOORD. & VAL. *Bijdr. Booms. Java* 9 (1903) 37; Atlas 1 (1913) t. 71; RIDL. *Fl. Mal. Pen.* 1 (1922) 864, f. 71; GILG, *l.c.*; KOOPMAN & VERHOEF, *Tect.* 31 (1938) 785-789, f. 4-5; MERR.

& PERRY, *J. Arn. Arb.* 23 (1942) 407.—*T. horsfieldii* STEUD. *Nomencl. ed. 2*, 2 (1841) 671, *nomen*; TEYSM. *Nat. Tijd. N.I.* 11 (1856) 195.—*T. grahamiana* WIGHT, *l.c.* (1853) t. 1956.—**Fig. 4-6.**

Large tree, 25-45 m, stem diam. up to 2 m; clear bole long, columnar, 20-35 m, often deeply



Fig. 4. *Tetrameles nudiflora* R.Br. a. Twig with young foliage,  $\times \frac{2}{3}$ —♂: b. inflorescence,  $\times \frac{2}{3}$ , c. flower,  $\times 4$ ,—♀: d. inflorescence,  $\times \frac{2}{3}$ , e. flower,  $\times 4$ , f. style,  $\times 14$ , g. fruit, calyx tube with many small, globular and 2 large, flat glands,  $\times 4$ . (Partly after R. BROWN, ♂ after BRASS 8240, ♀ after KOORDERS 1578, fruit after bb 6043).



Fig. 5. Flowering leafless specimen of *Tetrameles nudiflora* R.Br. on slope along the Lake of Bedali (E. Java) with characteristic gnarled main branches (RUTTNER).

fluted, main branches thick, gnarled, rather irregularly placed, little branched, crown thin; buttresses to 5 by 4 m, thin; bark 5–25 mm diam., grey, smooth, dirty-orange yellow in section, white striped; large spreading surface roots (BRASS). Leaf scars  $\frac{1}{2}$ – $\frac{3}{4}$  cm diam.. Leaves broadly cordate-ovate or rounded, acute to acuminate, coarsely dentate to nearly entire, 3–7-nerved, upper surface  $\pm$  glabrous, lower surface hairy in various degree specially on nerves and veins; tertiary venation crossbar-like; blade 10–26 by 9–20 cm. Petiole terete, 3–7(–20) cm. —♂ Flowers slightly fragrant in 10–20 cm long panicles. Bracts spatulate, hairy, ca 1 mm long. Pedicels glabrous, subsessile, to 1 mm. Calyx  $1\frac{1}{2}$ –2 mm high, deeply 4-lobed, basal part cup-shaped,  $\frac{1}{2}$  mm high; lobes oblong, blunt, with 3 separate lengthwise nerves, entire or 1–2-toothed. Filaments  $\frac{1}{2}$ – $3\frac{1}{2}$  mm, terete, thinner towards the apex, anthers rounded ca  $\frac{1}{2}$  mm.—

♀ Flowers sessile,  $3\frac{1}{2}$ –5 mm long, in spikes or panicles 8–20 cm long. Calyx sparsely hairy to subglabrous, tube  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm, fusiform, sometimes provided with a few  $\frac{1}{4}$ – $\frac{1}{2}$  mm diam. disk-shaped, sessile, peltate, glands (bb. 6043 from Muna Isl.). Calyx lobes triangular, acutish, 3-nerved,  $\frac{1}{2}$ –1 mm long. Styles 4 or nor rarely 5, 1– $2\frac{1}{2}$  mm, with a central groove on the inner surface, erect or spreading, stigmatic inner side often occupying half their length. Capsule globular-urceolate, 4–5 mm high, prominently 8–10-nerved. Seeds ca 1 mm long.

Distr. Ceylon, Andamans, and SE. Asia, in Malaysia: not yet found in Banka, Billiton, Borneo, the Philippines, and the Moluccas. Fig. 6.

Ecol. Restricted to regions with a more or less well pronounced dry season (which accounts for its absence in the everwet areas of West Malaysia), predominantly in deciduous forests, common in teak forest, not social, on dry soils, not fire-resistant, up to ca 500–(1000) m. Fl. fr. Sept.–Dec. (in the Mal. Pen. fl. Febr.). Flush and flowers appear at the beginning of the wet season.

Vern. Sumatra: *pěrlak*, Gajo, *kaliměhměh*, Karo, *kaju tabu*, *kundur*, S. Sum., *binong*, S., *běděřek*, winong, *kapasan ganggangan*, munung, J, *bindung*, Md, *bindung*, Kangean, *linong*, W. Lombok, *kotera*, W. Sumba, *manuang*, Alor, *bonak*, Timor, *palumba*, *maramindi*, Malili, *wonolita*, Muna, *bolaäng*, *itam*, *kola kola*, Minah., *bulangita*, Gorontalo, *andan boēmari*, Papua.

Uses. Timber, though to be had in large dimensions, is of an inferior quality; it is suitable for temporary buildings, wooden boxes (and matches?) and specially for canoes. Wood light brown-grey; heartwood is not present.

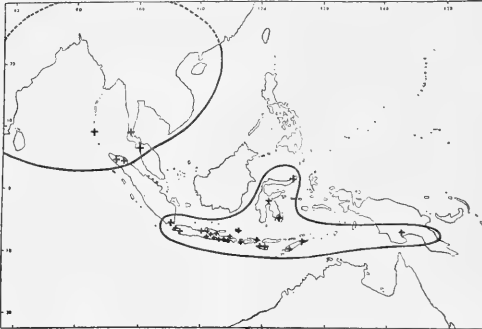


Fig. 6. Distribution of *Tetrameles nudiflora* R.Br. with localized Malaysian localities.

Excluded

*Tetrameles rufinervis* Miq. Fl. Ind. Bat. 1, 1 (1856) 726; Pl. Jungh. part 4 (1857) 401, is a *nomen confusum*; the type consists of leaves of *Alangium rotundifolium* (HASSK.) BLOEMB. and flowers of an entirely different plant. Cf. HALLIER f. Med. Rijks-herb. no 1 (1910) 12; 37 (1918) 5; BLOEMBERGEN, Bull. Jard. Bot. Btzg. III, 16 (1939) 180, 181, 183.

**CONVOLVULACEAE<sup>1</sup>** (S. J. van Ooststroom, Leyden,  
in collaboration with R. D. Hoogland<sup>2</sup>, Leyden)

Herbs or shrubs, sometimes parasitic, usually with twining stems, occasionally prostrate or creeping, or erect, very rarely trees, often with milky juice. *Leaves* mostly spirally arranged, in parasitic species absent or nearly so, usually petioled; petiole sometimes with extra-floral nectaries. *Stipules* absent, pseudostipules (leaves of axillary shoot) rarely present. *Inflorescences* mostly cymose, one- to many-flowered, with mostly opposite or subopposite bracts at the base of the cymes or under the solitary flowers; rarely racemose. *Flowers* generally hermaphrodite, actinomorphic, rarely slightly zygomorphic, usually 5-merous, rarely 4-merous, various in size and colour, often showy. *Sepals* usually free, imbricate, with quincuncial aestivation, often persistent, sometimes accrescent in fruit. *Corolla* sympetalous, of various shapes, often funnel-shaped or campanulate, more rarely rotate, salver-shaped or urceolate; the limb nearly entire or more or less deeply lobed, often contorted-plicate in bud, or valvate or induplicate-valvate. *Stamens* isomerous, alternating with the corolla-lobes, adnate to the corolla, with usually slender, often filiform filaments and introrse or laterally and longitudinally dehiscent anthers. Pollen smooth or spinulose. *Disk* mostly present, annular or cupular. *Ovary* superior, mostly of 2 carpels, 2- or 1-celled, sometimes 4-celled by development of accessory partitions, rarely of 3 carpels and 3-celled; ovules 2 in each carpel, sessile, erect, anatropous. *Style* 1, often filiform, simple or forked, or 2 free styles, rarely very short or absent. *Stigma* entire or 2-lobed, rarely 3-lobed, or stigmas 2-4, of various shape, globular or ellipsoid to filiform, sometimes applanate, rarely peltate, kidney-shaped, conical or funnel-shaped. *Fruit* a capsule dehiscent by valves or circumscissile or irregularly dehiscent, rarely a berry or nut-like. *Seeds* as many as ovules or fewer; endosperm cartilaginous; cotyledons generally folded, sometimes obscure or absent.

**Distr.** *Ca* 55 genera, with *ca* 1650 *spp.*, widely distributed in the tropical, subtropical and temperate regions of both hemispheres; the greater part of the species in the tropics and subtropics of America and Asia. The larger genera *Cuscuta* (*ca* 165 *spp.*), *Convolvulus* (*ca* 250 *spp.*) and *Ipomoea* (*ca* 500 *spp.*) nearly throughout the range of the family but *Convolvulus* more in the temperate parts and *Ipomoea* more in the tropics and subtropics. Other large genera as *Evolvulus* (*ca* 100 *spp.*) and *Jacquemontia* (*ca* 120 *spp.*) nearly confined to America, *Argyreia* (*ca* 90 *spp.*) confined to tropical Asia, Malaysia, and a single *sp.* in Australia, and *Merremia* (*ca* 80 *spp.*) circumtropical. Several monotypic or small genera in E. Africa, Madagascar, and Australia.

**Ecol.** By far the greater part of the species are found in localities where they are fully exposed to the sunlight. As far as they do not prefer open fields and similar places, they often occur along edges of thickets and forests. In the primary forest flora representatives of the family are pretty rare.

Some *Convolvulaceae* take part in covering or entangling other vegetation either or not associated with other vines of *Cucurbitaceae*, *Vitaceae* etc. described by VAN STEENIS as 'vegetable blankets' (Trop. Natuur 28, 1939, 141-149). Typical instances of this kind are specially found in seral pioneer vegetation, or in thickets and secondary forest, e.g. *Merremia peltata* (L.) MERR., *Ipomoea gracilis* R.Br. A typical example of the luxurious festoons of the latter species is found in the fringe of beach-forest of *Casuarina equisetifolia* on the Island of Krakatau of which some crowns are spun round like cocoons (fig. 42). Practical use of this habit might be made in plantations, where some *Convolvulaceae* could be used as a cover crop. They are, however, inferior to the *Leguminosae* with similar qualities, in being devoid of rootnodules containing nitrogen-fixing bacteria.

The flowers are visited by insects and birds for the nectar excreted by the disk. Species of *Ipomoea*

(1) Treatment mostly after VAN OOSTSTROOM, The Convolvulaceae of Malaysia, Blumea 3<sup>1</sup> (1938) 62-94; 3<sup>2</sup> (1939) 267-371; 3<sup>3</sup> (1940) 481-582; 5<sup>2</sup> (1943) 339-411; 5<sup>3</sup> (1945) 689-691; 6<sup>2</sup> (1950) 337-348; 7<sup>1</sup> (1952) 171-178; and HOOGLAND, *ibid.* 7<sup>1</sup> (1952) 179-192; 7<sup>2</sup> (1953) 310-319.

(2) In *Argyreia* (partly) and *Erycibe*.

*sect. Calonyction* with long and narrow corolla tubes, of which several fragrant white-flowered species are nocturnal, are visited by long-tongued *Sphingidae*. The salver-shaped scarlet-coloured corolla of *sect. Quamoclit* is distinctly fit for honey-sucking colibris; in Java VAN DER PIJL observed by both species that sun-birds suck honey by perforating the basal part of the tube (Trop. Natuur 17, 1928, 187; Hong Kong Nat. 5, 1934, 178-179). In *Ipomoea pes-caprae* DOCTERS VAN LEEUWEN (Ann. Jard. Bot. Btzg 37, 1927, 19-20) found flowers visited by *Xylocopa* and other *Hymenoptera*. Flowers of *Ipomoea congesta* are at Bogor regularly visited by *Hesperidae* (VAN STEENIS). The flowers of many species remain open for one day only or for a few hours, specially in the morning.

Some species possess extra-floral nectaries, at the leaf-base, the petiole or the calyx (see NIEUWENHUIS-VON ÜXKÜLL-GÜLDENBANDT, Ann. Jard. Bot. Btzg 21, 1907, 253-256).

Cauliflory is exceptional; it is found in *Erycibe ramiflora* HALLIER f. and in *Argyreia nuda* OOSTSTR. *Convolvulaceae* are autotrophic with exception of the parasitic genus *Cuscuta*. *Parasitipomoea formosana* HAYATA is conspecific with *Ipomoea congesta* R. BR.

According to RIDLEY (Dispersal, etc. 1930, 302-307) the seeds of a number of species of *Convolvulaceae* are undoubtedly widely dispersed by seawater. Among these are *Ipomoea pes-caprae* (L.) SWEET, *I. stolonifera* (CYRILL.) GMEHL., *I. gracilis* R. BR., *I. tuba* (SCHLECHTEND.) DON and *I. illustris* (CLARKE) PRAIN. These species are found along the coast or immediately behind it; some of them are confined to sandy beaches, very rarely they occur more inland. Of others, like *Operculina turpethum* (L.) S. MANSO, *Merremia peltata* (L.) MERR., and *Stictocardia tilifolia* (DESR.) HALLIER f., RIDLEY also assumes a dispersal by seawater. These species also occur on or near the coast, but they are often found also in more inland localities. The buoyancy of the seeds is due to an unoccupied space inside the testa.

SVEDELIUS (Flora 96, 1906, 231-259) has described 'water-calyces' in *Stictocardia tilifolia* (DESR.) HALLIER f., *Operculina turpethum* (L.) S. MANSO, and some other species of *Convolvulaceae*.

Morph. The climbing capacity of *Convolvulaceae* is exclusively effected by the twining of the stem which is always to the right (compare p. 300, fig. 4c).

Anat. HALLIER, H., Versuch einer natürlichen Gliederung der Convolvulaceen auf morphologischer und anatomischer Grundlage (Bot. Jahrb. 16, 1893, 455-591).

The value of pollen-characters for the subdivision of the family has been described by HALLIER (l.c. 517-520).

Terat. Cf. COSTERUS & SMITH, Ann. Jard. Bot. Btzg 19 (1904) 159; 42 (1932) 11.

Galls. Cf. DOCTERS VAN LEEUWEN, The Zooecidia of the Netherlands Indies (1926) 472-478; id. Ned. Kruidk. Arch. 51 (1941) 224.

Uses. Of importance as food plants are *Ipomoea aquatica* FORSK. and *Ipomoea batatas* (L.) LAMK, both cultivated throughout the tropics, the former as a vegetable, the latter for its edible tubers (sweet potato).

Several species are used in native medicine, often on account of their purging properties, e.g. *Operculina turpethum* and species of *Merremia* and *Ipomoea*. Species of *Porana*, *Jacquemontia*, *Ipomoea*, *Mina*, and *Turbina* are grown as ornamental plants; *Ipomoea pes-caprae* is sometimes planted on sandy coasts as a sand-binder.

Notes. The family *Convolvulaceae* is subdivided into two subfamilies, viz A. *Cuscutoideae* containing as only tribe and subtribe I. CUSCUTEAE resp. i. *Cuscutinae* and B. *Convolvuloideae* containing two tribes, viz II. CONVOLVULAEAE (*Psiloconia* HALLIER f.) with smooth pollen (subtribes ii-vii) and III. IPOMOEAEAE (*Echinoconia* HALLIER f.) with spinulose pollen (subtribes viii-ix). There is only a small discrepancy in rank and circumscription between this division and that proposed by H. HALLIER (Bot. Jahrb. 16, 1893, 567, 582) who described as tribes, the taxa here accepted as subtribes (l.c. 567-585).

The taxa just mentioned are represented in Malaysia as follows:

Subfamily A. *Cuscutoideae*.

Tribe I. *Cuscutae*. Subtribe i. CUSCUTINAE: 1. *Cuscuta* L.

Subfamily B. *Convolvuloideae*.

Tribe II. *Convolvulae*. Subtribe ii. WILSONIINAE: not represented in Malaysia. Subtribe iii. DICHONDRINAE: 2. *Dichondra* FORST.. Subtribe iv. DICRANOSTYLINAE: 3. *Evolvulus* L., 4. *Bonamia* THOU., 5. *Neuropeltis* WALL.. Subtribe v. PORANINAE: 6. *Porana* BURM. f. Subtribe vi. ERYCIBINAE: 7. *Erycibe* ROXB.. Subtribe vii. CONVOLVULINAE: 8. *Jacquemontia* CHOISY, 9. *Aniseia* CHOISY, 10. *Convolvulus* L., 11. *Calystegia* R. BR., 12. *Hewittia* W. & A., 13. *Merremia* DENNST. ex HALLIER f., 14. *Operculina* S. MANSO, 15. *Decalobanthus* OOSTSTR.

Tribe III. *Ipomoeae*. Subtribe viii. IPOMOEINAE: 16. *Ipomoea* L., 17. *Mina* CERV., 18. *Lepistemon* BL.. Subtribe ix. ARGYREINAE: 19. *Stictocardia* HALLIER f., 20. *Turbina* RAFIN., 21. *Argyreia* LOUR.

Collecting and identifying *Convolvulaceae*.—As appears from the key to the genera it is impossible to identify sterile specimens. In several cases even flowering materials are insufficient for generic identification (e.g. to discriminate between the genera *Operculina* and *Merremia* or between *Ipomoea* and *Argyreia*) and fruits are needed. This results in the disadvantage that a trustworthy key can only be framed on the basis of complete material. The use of the surface structure of the pollen, i.e. whether it is smooth or spinulose, could not be avoided. This looks worse than it really is, as the spinulose surface of the pollen of *Ipomoeae* can mostly be observed with a 10 times magnifying hand lens; however, in other cases a microscope is needed.

Explorers are invited to take care to collect convolvulaceous plants with both flowers and fruits, and to make good notes on the shape and colour of the flower, and also to dry the flowering specimens immediately after collecting as the corollas are in many cases liable to wilt soon.

The shape of the corolla is rather important for identification; it may be convenient to explain the shape-concepts by reference to the figures: *funnel-shaped*: fig. 10, 26, 28. *funnel-shaped to campanulate*: fig. 58, *rotate*: fig. 5, *salver-shaped*: fig. 34, 53, 54, *urceolate*: fig. 56.

## KEY TO THE GENERA

1. Leafless, parasitic plants with haustoria. Flowers small, in clusters or short racemes. Corolla mostly with 5 episepalous fimbriate scales inside (*Cuscutoidae*) . . . . . **1. Cuscuta**
1. Non-parasitic plants with green leaves (*Convolvuloideae*).
2. Pollen not spinulose (*Convolvuleae*).
3. Ovary deeply 2-lobed; styles 2, inserted between the lobes (gynobasic). Flowers small, solitary, axillary. Corolla deeply 5-lobed. Small creeping herbs. Leaves kidney-shaped or cordate-orbicular . . . . . **2. Dichondra**
3. Ovary not deeply 2-lobed; style(s) not gynobasic.
4. Style absent; stigma 1, conical or semiglobular, 5–10-rayed, rarely funnel-shaped in apical centre. Corolla-lobes bifid. Ovary 1-celled. Fruit fleshy or woody, indehiscent. Woody twiners or straggling shrubs, rarely small trees . . . . . **7. Erycibe**
4. Style(s) present, sometimes very short; stigma(s) otherwise.
5. Outer 3 or all of the sepals much enlarged in fruit, patent, scarious, reticulately veined, falling off with the fruit. Flowers in racemes or panicles. Corolla-limb subentire or lobed. Style 1, entire or bifid. Woody or herbaceous twiners . . . . . **6. Porana**
5. Sepals either enlarged in fruit or not so, remaining attached to the pedicel after dehiscence of the fruit.
6. Styles 2, free or united near the base.
7. Styles united below; stigmas globular to peltate; ovary hairy. Flowers in axillary peduncled cymes. High twiners . . . . . **4. Bonamia**
7. Styles free.
8. Each style forked and with 2 filiform or slightly clavate stigmas. Corolla-limb nearly entire. Bracts not distinctly enlarged in fruit. Small herbaceous plants, never twining. . . . . **3. Evolvulus**
8. Each style with a kidney-shaped lobed stigma. Corolla-limb deeply 5-lobed. Bracts much enlarged in fruit and scarious. Large woody twiners . . . . . **5. Neuropeltis**
6. Style 1, entire, or with 2 minute branches, concealed by the stigmas. Herbaceous twiners or prostrate plants, or woody twiners.
9. Corolla salver-shaped; limb distinctly 5-lobed with bifid lobes; tube fleshy, cylindrical. Stigmas globose . . . . . **15. Decalobanthus**
9. Corolla funnel-shaped or campanulate; limb entire or slightly lobed.
10. Sepals enclosed by two large bracts. Corolla pink, or purple. Stigmas oblong or elliptic, complanate . . . . . **11. Calystegia**
10. Sepals not enclosed by bracts.
11. Hairs on stems and leaves stellate. Corolla blue, lilac, pink or rarely white. Stigmas elliptic, oblong or linear, rarely globose. Leaf-base cordate or truncate, never hastate or sagittate. . . . . **8. Jacquemontia**
11. Hairs not stellate (or absent).
12. Outer sepals acute or acuminate, much longer and broader than the inner ones. Stems not winged.
13. Outer sepals decurrent on the pedicel. Corolla white. Ovary glabrous; stigmas globular to oblong. Valves of the capsule silvery white and shining inside. Leaves oblong, narrowed towards the base . . . . . **9. Aniseia**
13. Outer sepals not decurrent on the pedicel.
14. Midpetaline bands distinctly pilose outside. Corolla white or cream-coloured, with or without a purple centre. Ovary hairy; stigmas ovate-oblong, complanate. . . . . **12. Hewittia**
14. Corolla glabrous or nearly so, pale blue, lilac or rarely white. Ovary glabrous; stigmas elliptic or filiform . . . . . **8. Jacquemontia**
12. Outer sepals not both distinctly longer and broader than the inner ones and acute or acuminate.
15. Stigmas filiform or elliptic.
16. Stigmas filiform. Corolla white or pink. Leaf-base mostly hastate or sagittate. . . . . **10. Convolvulus**
16. Stigmas elliptic. Corolla blue or lilac. Leaf-base truncate, rounded or slightly cordate, not hastate or sagittate . . . . . **8. Jacquemontia**
15. Stigmas globular.



17. Capsule circumscissile; upper part of the epicarp separating from the lower part and from the endocarp. Corolla white or pale yellow, without purple centre. Stems terete or winged . . . . . 14. *Operculina*
17. Capsule opening by 4 valves or more or less irregularly dehiscent. Corolla white, pale or bright yellow, sometimes with a purple centre. Stems not winged . . . . . 13. *Merremia*
2. Pollen spinulose (*Ipomoeae*).
18. Corolla broadly or narrowly urceolate, at the base either narrowed into a short tube, or not.
19. Corolla actinomorphic, urceolate, not narrowed at the base into a short tube. Stamens shorter than the corolla. Filaments dilated at their base into a concave scale, arched over the ovary. . . . . 18. *Lepistemon*
19. Corolla  $\pm$  zygomorphic, narrowly urceolate, at the base narrowed into a short tube. Stamens longer than the corolla. Filaments not dilated into a concave scale . . . . . 17. *Mina*
18. Corolla tubular, campanulate, funnel-shaped or salver-shaped.
20. Calyx in fruit much enlarged, completely enclosing the ripe fruit. Leaf-blades with minute black dots (glands) beneath . . . . . 19. *Stictocardia*
20. Calyx enlarged or not enlarged in fruit, not completely enclosing the ripe fruit. Leaf-blades without black dots beneath.
21. Fruit a thin-walled capsule opening by valves or irregularly dehiscent. Herbaceous or rarely woody twining or prostrate, rarely erect plants. Corolla mostly glabrous outside 16. *Ipomoea*
21. Fruit indehiscent; pericarp fleshy or leathery, or more or less woody.
22. Fruit fleshy or leathery, purple, red or yellowish, globose or ellipsoid, not or indistinctly mucronate by the style-base. Seeds glabrous or rarely pilose at the hilum. Corolla outside mostly with hairy midpetaline bands. Woody twiners . . . . . 21. *Argyriaea*
22. Fruit with a thin woody pericarp, ovoid-oblong, distinctly mucronate by the style-base. Seeds puberulent. Corolla glabrous, or sparsely hairy, white. Herbaceous or subwoody twiner. . . . . 20. *Turbina*

1. CUSCUTA

LINNÉ, Sp. Pl. ed. 1 (1753) 124; Gen. Pl. ed. 5 (1754) 60; YUNCKER, Mem. Torr. Bot. Club 18 (1932) 113; OOSTSTR. Blumea 3 (1938) 63.—Fig. 1-2.

Herbaceous parasites with slender, often filiform, twining, yellow or reddish stems, with haustoria. *Leaves* reduced to minute scales. *Flowers* small, mostly in cymose clusters, 5-, rarely 4- or 3-merous. *Calyx* more or less deeply lobed, or consisting of free sepals. *Corolla* tubular, urceolate, globose or campanulate; the tube with crenulate or fimbriate episepalous scales inside. *Stamens* as many as corolla-lobes, inserted on the corolla above the scales; pollen ellipsoid, smooth. *Ovary* 2-celled, each cell with 2 ovules. *Styles* 2, distinct, or 1; stigmas globose, subglobose or elongated. *Fruit* an ovoid or globose, dry or fleshy capsule, opening irregularly, circumscissile, or remaining closed. *Seeds* 4 or less, glabrous; embryo acotyledonous, filiform, enlarged at one end.

Distr. Cosmopolitan, rather large genus, estimated at *ca* 165 *spp.*, centering in the Americas, few in Malaysia, not represented in Borneo, the Philippines, Celebes, and the Moluccas.

Vern. *Dodder*, *E, duivelsnaaigaren*, *warkruid*, *D.*

Note. Rather often confounded with the Lauraceous genus *Cassytha* which is similar in habit, but easily distinguishable by 3-merous flowers and globular berries.

KEY TO THE SPECIES

1. Styles 2, distinct. Stigmas depressed-globose (*Subgenus Grammica*).
2. Corolla-lobes obtuse; calyx-lobes not overlapping; corolla-scales short, deeply bifid, with few fimbriae . . . . . 1. *C. australis*
2. Corolla-lobes acute; calyx-lobes slightly overlapping at the base; corolla-scales ovate, not bifid, abundantly fimbriate . . . . . 2. *C. campestris*
1. Style 1, or nearly absent. Stigmas depressed-globose or elongated (*Subgenus Monogyna*).
3. Style longer than the depressed-globose stigmas; corolla-tube as long as the lobes; corolla-scales represented by narrow wings . . . . . 3. *C. timorensis*
3. Style shorter than the elongate stigmas; corolla-tube  $2\frac{1}{2}$ -3 times as long as the lobes; corolla-scales ovate to oblong, abundantly fimbriate . . . . . 4. *C. reflexa*



1. Subgenus *Grammica*

(LOUR.) YUNCKER, Mem. Torr. Bot. Club 18 (1932) 122; OOSTSTR. Blumea 3 (1938) 64.—*Grammica* LOUR. Fl. Cochinch. 1 (1790) 170.—*Cuscuta* group *Grammica* ENGELM. Trans. Ac. Sc. St Louis 1 (1859) 459, 460.

Flowers mostly pedicelled. Styles 2; stigmas mostly globose or depressed-globose; capsule opening by circumscission, or remaining closed.

Note. YUNCKER divided this subgenus into two sections, 1. *Clistogrammica* ENGELM. em. YUNCK., with indehiscent capsules and 2. *Eugrammica* ENGELM., with circumscissile capsules. Only the first section is represented in Malaysia.

1. *Cuscuta australis* R.Br. Prod. (1810) 491; YUNCKER, Mem. Torr. Bot. Club 18 (1932) 124; OOSTSTR. Blumea 3 (1938) 66.—*C. obtusiflora* H.B.K. var. *australis* ENGELM. Trans. Ac. Sc. St Louis 1 (1859) 492.—*C. hygrophilae* PEARSON in HOOK. Ic. Pl. IV, 8 (1901) t. 2704.—*C. chinensis* (non LAMK.) KOORD. Exk. Fl. Java 3 (1912) 109.—*C. nuda* PILGER, Bot. Jahrb. 59 (1924) 84.—Fig. 1. Stems thin, filiform, greenish yellow to orange. Flowers 2–2½ mm long, in compact clusters. Calyx about as long as corolla-tube; lobes ovate to orbicular, obtuse. Corolla white, greenish white or creamy white; lobes slightly shorter than or as long as the tube, broadly ovate or narrower, obtuse or

subobtusate, erect or spreading. Stamens slightly shorter than the corolla-lobes; filaments as long as or longer than the anthers. Corolla-scales short, deeply bifid with few long fimbriae. Styles shorter than the depressed-globose ovary. Capsule depressed-globose or obpyriform, 3–4 mm diam., with large interstyler opening, not circumscissile. Seeds 4–3, oval, 1½ mm long, brownish.

Distr. C., S. and E. Asia to Australia, in Malaysia: Sumatra, Malay Peninsula, Java, and New Guinea.

Ecol. According to YUNCKER often on *Polygonum* but also on many other herbaceous plants as *Artemisia*, *Dianthera*, *Genista*, *Glycine soja*, *Lespedeza*, *Pelargonium*, *Piper*, *Xanthium*, etc.

In Malaysia also on *Baccaurea*, *Codiaeum*, *Croton*, *Dianthera leptostachya* BENTH., *Hygrophila quadrivalvis* NEES, *Nothopanax scutellarium* (BURM.) MERR., *Ocimum basilicum* L., *Piper aduncum* L., *Pluchea indica* LESS., *Polyscias*, *Tecoma stans* JUSS.; 5–500 m.

According to an annotation on a field-label by MILNE, in herb. Sing., this species is regarded as a pest and is said to be liable to become dangerous (Malay Peninsula).

Use. The seeds are used in the native medicine-trade; acc. to VORDERMAN seeds are for this aim introduced from China. Softening properties are attributed to them (HEYNE).

Vern. Djamudju, mamudju, mudju-mudju, tja-tjingan, J, majamuju, Md, ramat émas, S.

Notes. The dimensions of the corolla-scales are rather variable; in general they are rather obvious; sometimes, however, they are very small and are easily overlooked. Concerning the form and dimensions of the calyx-lobes may be said that in many cases their length and width is rather equal, in others they can considerably vary; the corolla-lobes are, as a rule, obtuse; somewhat acute lobes also occur.

2. *Cuscuta campestris* YUNCKER, Mem. Torr. Bot. Club 18 (1932) 138; OOSTSTR. Blumea 3 (1938) 68.—*C. arvensis* BEYRICH ex ENGELM. in A. GRAY, Man. Bot. ed. 2 (1856) 336, p.p.—*C. pentagona* ENGELM. var. *calycina* ENGELM. Am. J. Sc. & Arts 45 (1845) 76.—*C. arvensis* ENGELM. var. *calycina* ENGELM. Trans. Ac. Sc. St Louis 1 (1859) 495.

Stems thin, filiform, yellowish. Flowers 2–2½ mm long, in compact clusters. Calyx about as long as the corolla-tube; lobes orbicular, rounded, slightly overlapping at the base. Corolla-lobes



Fig. 1. *Cuscuta australis* R.Br. a. Habit,  $\times 1/2$ , b. opened corolla, from inside,  $\times 3$ , c. corolla-scale,  $\times 6$ .

about as long as the tube, broad-triangular, acute, spreading, with erect or inflexed tips. Stamens slightly shorter than the corolla-lobes; filaments as long as or longer than the anthers. Corolla-scales exerted, ovate, abundantly fimbriate. Styles about as long as the depressed-globose ovary. *Capsule* depressed-globose, 3 mm in diam., with interstylar opening, not circumscissile. *Seeds* ca 2, ovate, with one flattened side.

Distr. Native of N. America, now cosmopolitan, in *Malaysia*: W. and M. Java.

Ecol. Often on *Medicago sativa*, *Trifolium*, and *Satureja hortensis*, but also on a great number of

other herbaceous plants; acc. to YUNCKER on *Ambrosia*, *Ammi*, *Artemisia*, *Aster*, *Beta*, *Bidens*, *Callistephus*, *Capsicum*, *Cirsium*, *Dianthera*, *Ipomoea*, *Pelargonium*, *Sonchus*, *Xanthium*, etc. (see VAN OOSTSTROOM, Ned. Kruidk. Arch. 52 (1942) 166). The specimens from Java on *Cinchona*, *Cosmos*, *Crotalaria anagyroides* H.B.K., *C. usaramoensis* BAKER f., and *Gynura crepidioides* BENTH.; 1000–1600 m.

Note. Mentioned by VAN STEENIS, Trop. Natuur 29 (1940) 36 and l.c. 30 (1941) 14. The specimen in the latter paper from Tegal Pandjang (W. Java) belongs to *C. reflexa* ROXB.

## 2. Subgenus *Monogyna*

(ENGELM.) YUNCKER, Mem. Torr. Bot. Club 18 (1932) 248; OOSTSTR. Blumea 3 (1938) 69.—*Cuscuta* group *Monogyna* ENGELM. Trans. Ac. Sc. St. Louis 1 (1859) 460.

Flowers sessile or shortly pedicelled. Style 1; stigmas globose, ovate, conic or flattened; capsule circumscissile.

Note. Two sections can be distinguished, viz. 1. *Monogynella* ENGELM., with the style as long as or longer than the stigmas, and 2. *Callianche* ENGELM., with the style shorter than the stigmas. To the first section belongs as only Malaysian species *C. timorensis*, to the second monotypic section *C. reflexa*.

3. *Cuscuta timorensis* DECNE ex ENGELM. Trans. Ac. Sc. St. Louis 1 (1859) 514; YUNCKER, Mem. Torr. Bot. Club 18 (1932) 250; OOSTSTR. Blumea 3 (1938) 69.—*C. monogyna* (non VAHL) auctt. mal.; see Blumea l.c.

Stems coarse, up to 2 mm or more in diam., brownish- or yellowish-red. *Flowers* in short racemes on very short pedicels in the axils of broadly triangular obtuse bracts; the common peduncle simple or occasionally branched near the base. *Calyx* cupulate, persistent, lobes orbicular, broadly rounded, overlapping, with more or less unequal edges. *Corolla* yellowish-white, campanulate, 3–3½ mm long, remaining on the developing capsule; lobes as long as the tube, ovate, obtuse, crenulate, erect or reflexed. Stamens subsessile or filaments much shorter than the anthers, inserted at the sinus. Corolla-scales represented by narrow wings. Ovary ovate-conical. Style longer than the depressed-globose stigmas. *Capsule* ovate-oblong, mucronate by the style, circumscissile near the base, 5 mm high, without opening at the top; 1–2-seeded.

Distr. Central Africa (acc. to YUNCKER) and *Malaysia*: E. Java (Asembagus) and Lesser Sunda Islands (Timor, Wetar).

Ecol. On *Ficus glomerata* ROXB. and other woody plants; the only specimen from Java, at ca 10 m, in a very dry locality. Apparently confined to regions with a pronounced dry season.

Note. I did not see African specimens, but YUNCKER states that he is 'unable to distinguish between the Malayan forms of the species and those examined from Africa.'

4. *Cuscuta reflexa* ROXB. Pl. Corom. 2 (1798) 3, t. 104; YUNCKER, Mem. Torr. Bot. Club 18 (1932) 259; OOSTSTR. Blumea 3 (1938) 70.—*C. macrantha* G. DON, Gen. Syst. 4 (1838) 305.—Fig. 2.

Stems coarse, up to 2½ mm or more in diam.,

pale green or yellowish green. *Flowers* in small groups, or in racemes, or in racemes consisting of small flower-groups, sessile or very shortly pedicelled. *Calyx* cupulate, lobes orbicular, obtuse, overlapping, the back verrucose-carinate. *Corolla* creamy or white, campanulate-tubular, 6–10 mm long, at first remaining on the developing capsule; tube 2½–3 times as long as the lobes; lobes narrow-ovate to ovate-triangular, obtuse or subacute, crenate or entire, erect, spreading or reflexed. Filaments very short, inserted just below the sinus. Corolla-scales ovate to oblong, abundantly fimbriate. Ovary ovate-conical. Style shorter than the elongate stigmas. *Capsule* globose-conical, circumscissile near the base, 4- or less-seeded; seeds 3–3½ mm long, black.

Distr. From Afghanistan and Baluchistan throughout N. India to Yunnan, China, Siam, and Ceylon; in *Malaysia*: Java, in the E. half of the island, in W. Java only found once on Tegal Pandjang, Mt Papandajan (cf. sub *C. campestris*). The identification of specimens from Kedu, Madiun and Ponorogo, found between ca 800 and 1400 m, is uncertain, as they have been collected without flowers.

Ecol. On *Achyranthes*, *Adhatoda*, *Apluda*, *Aquilegia*, *Calotropis*, *Capparis*, *Carissa*, *Citrus*, *Clerodendron*, *Cocculus*, *Coffea*, *Duranta*, *Fragaria*, *Lavatera*, *Melia*, *Nerium*, *Parkinsonia*, *Peristrophe*, *Thevetia*, *Viburnum*, *Zizyphus* (YUNCKER).

In Java moreover on *Artemisia vulgaris* L., *Boehmeria clidemioides* MIQ., *Casuarina*, *Cestrum*, *Engelhardtia spicata* BL., *Euphorbia rothiana* SPR., *Fuchsia coccinea* AIT., *Justicia gendarussa* L., *Maoutia diversifolia* (BL.) WEDD., *Polygonum chinense* L., *Rubus horsfieldii* MIQ., *Stachytarpheta*; sometimes in dense masses, covering whole tree-crowns, or covering lower vegetation like a net; (1000–)1500–2700 m.

Vern. *Ulan-ulan*, J, from *ulo* = serpent.



Fig. 2. *Cuscuta reflexa* ROXB. forming garlands over a large tree, near Tosari, E. Java, ca 2200 m (E. C. J. MOHR).

## 2. DICHONDRA

FORST. Char. Gen. (1776) 39, t. 20; OOSTSTR. Blumea 3 (1938) 72.—Fig. 3.

Small creeping herbs, glabrous or softly hairy. *Leaves* mostly small, petioled, kidney-shaped or orbicular-cordate, entire. *Flowers* small, solitary in the leaf-axils; bracts minute. *Sepals* 5, free, subequal, often spatulate, herbaceous. *Corolla* regular, widely campanulate, deeply 5-lobed; lobes induplicate-valvate or slightly imbricate. *Stamens* shorter than the corolla; filaments filiform; anthers small; pollen smooth. Disk small, cupular. *Ovary* deeply 2-lobed, each lobe with 2 ovules; styles 2, filiform, gynobasic (inserted between the lobes); stigmas capitate. *Capsule* 2-lobed; lobes erect, 1- or rarely 2-seeded, indehiscent or irregularly 2-valved. Seeds subglobose, smooth.

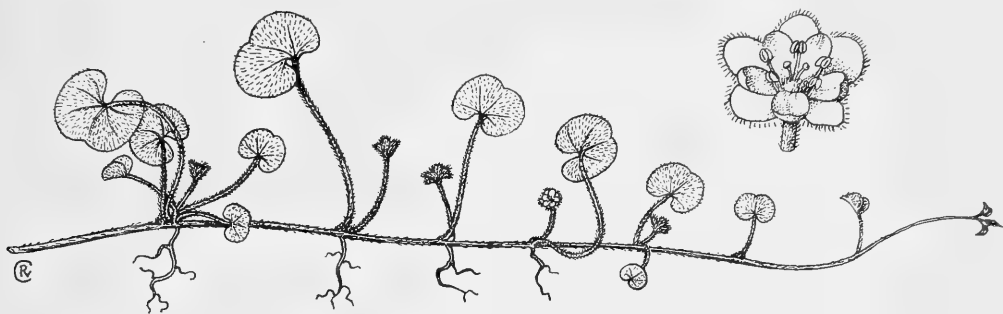


Fig. 3. *Dichondra repens* FORST. Habit, nat. size and flower,  $\times 5$ .

Distr. A small genus of 4-5 species, principally American; one species in the tropical and sub-tropical regions of both hemispheres.

1. *Dichondra repens* FORST. Char. Gen. (1776) 40, t. 20; OOSTSTR. Blumea 3 (1938) 73.—Fig. 3.

A small creeping, perennial herb. Stems slender, shortly hairy, rooting at the nodes. Leaves long-petioled, kidney-shaped to orbicular, 4-25 mm diam., broadly cordate at the base, broadly rounded or emarginate at the apex, appressedly hairy, especially beneath. Flowers axillary, solitary; pedicel mostly shorter than the petiole, filiform. Sepals obovate-oblong to spatulate, obtuse, ca 2-3 mm long, hairy on the back and at the margins. Corolla shorter to slightly longer than the calyx,

deeply 5-lobed, yellowish. Carpels pilose. Seeds yellow to brown, glabrous.

Distr. Ubiquist, in the warmer regions of the globe everywhere local; in Malaysia: Philippines (Luzon).

Ecol. On dry slopes, ca 1300 m.

Vern. Philippines: *Lutlutud*, Bon., *napalapayag*, Ilk..

Note. The species shows a resemblance in habit with *Merremia emarginata* (BURM. f.) HALLIER f., with which it has been confounded in the herbaria.

### 3. EVOLVULUS

LINNÉ, Sp. Pl. ed. 2 (1762) 391; OOSTSTR. Mon. Evolv., Thesis, Utrecht (1934) 19; Blumea 3 (1938) 74.—Fig. 4-5.

Annual or perennial herbs, undershrubs, or shrubs; stems prostrate, ascending or erect, never twining. Leaves mostly small, entire. Flowers in axillary, mostly peduncled, one- to several-flowered cymes, or solitary, pedicelled or sessile in the leaf-axils, or aggregate in terminal spikes or heads. Sepals 5, small, equal or subequal, acuminate, acute or obtuse, not enlarged in fruit. Corolla regular, mostly small, rotate, funnel- or salver-shaped, purple, blue or white, rarely yellow; limb sub-entire to distinctly 5-lobed; midpetaline bands often pilose outside. Stamens 5, included or exserted; filaments adnate to the corolla-tube, filiform, glabrous, occasionally with a tooth at both sides of the base; pollen globular, smooth. Disk small, cupular, or absent. Ovary glabrous or sometimes pilose, 2-celled, each cell with 2 ovules, rarely 1-celled, 4-ovuled; styles 2, filiform, united at the base, or free, each style 2-cleft; stigmas long, terete, filiform or slightly clavate. Capsule globose or ovoid, 2-1-celled, mostly 4-valved. Seeds 4-1, smooth or minutely verrucose, glabrous.

Distr. Ca 98 spp., all in America from the S. United States to Argentina, two of these also in the Old World, of which the polymorphic *E. alsinoides* (L.) L. occurs with ca 16-17 varieties throughout the tropical and subtropical regions of the globe.

1. *Evolvulus alsinoides* (LINNÉ) LINNÉ, Sp. Pl. ed. 2 (1762) 392; OOSTSTR. Mon. Evolv. (1934) 26; Blumea 3 (1938) 74.—*Convolvulus alsinoides* LINNÉ, Sp. Pl. ed. 1 (1753) 157.—Fig. 4-5.

#### KEY TO THE VARIETIES

1. Leaves more or less distinctly in two rows, approximate; internodes up to 4 mm. Stems prostrate, rarely ascending.

2. Indumentum of stems and leaves dense, shining, sericeo-villose, fulvous. Leaves more or less imbricate . . . *var. philippinensis*
2. Indumentum much less dense, not obviously shining. Leaves not imbricate. *var. hirsutus*
1. Leaves mostly not distinctly in two rows, more remote; internodes mostly longer. Stems mostly ascending, sometimes erect, rarely prostrate.
3. Leaves *ca*  $1\frac{1}{2}$ – $2\frac{1}{2}$  times as long as broad, obtuse to emarginate at the apex.
- var. alsinoides*
3. Leaves  $2\frac{1}{2}$  or mostly more times as long as broad, mostly acute or acuminate, the basal ones sometimes obtusish.
4. Leaves appressed-pilose mostly on both sides.
5. Peduncles shorter than the leaves. Indumentum more or less shining.
- var. javanicus*
5. Peduncles longer than the leaves. Indumentum less shining. *var. decumbens*
4. Leaves with appressed and spreading hairs, sometimes lanate . . . *var. sericeus*

*var. alsinoides*.—*E. pumilus* SPANOGHE in HOOK. Comp. Bot. Mag. 1 (1835) 348, *nom. nud.*?—*E. linifolius* (non L.) BLANCO, Fl. Filip. (1837) 221.—*E. pseudo-incanus* SPANOGHE, Linnaea 15 (1841) 341, *nom. nud.*

A perennial herb. Stems few to several, prostrate or ascending, slender, with appressed and patent hairs. *Leaves* oblong, elliptic or spatulate, 7–20 (–25) by 3–10 mm, rounded at the base or attenuate into the short petiole, obtuse or shallowly emarginate and mucronulate at the apex, more or less densely appressed-pilose on both sides, or sometimes glabrous above. *Peduncles* filiform, shorter to much longer than the leaves, hairs appressed, either mixed with patent ones or not, one- to few-flowered. Pedicels as long as or usually longer than the calyx. Bracts linear-subulate to linear-lanceolate,  $1\frac{1}{2}$ –4 mm long. *Sepals* lanceolate, acute or acuminate, *ca* 3 mm long, villose. *Corolla* rotate,  $5\frac{1}{2}$ –7(–10) mm diam., pale-blue or white. Ovary glabrous. *Capsule* globular, glabrous, 4-valved. Seeds 4 or less, black, smooth.

Distr. Tropical E. Africa, Madagascar, India, Indo-China, S. China, in *Malaysia*: Lesser

Sunda Islands (Timor), Philippines (Luzon).

Ecol. The Malaysian varieties of the species in dry, open, rocky localities, in dry grasslands, often on limestone, at low and medium altitudes.

Note. In Timor and the Philippines both typical specimens and transitions to *var. decumbens* are found. Some collections from E. Java (Surabaja, Grisee) also represent such transitions.

*var. hirsutus* (LAMK) OOSTSTR. Mon. Evolv. (1934) 29.—*E. hirsutus* LAMK, Enc. 3 (1789) 538.

Stems mostly rather stout, prostrate, or sometimes ascending, 7–15(–35) cm, appressed- and patently pilose or almost tomentose in the young parts with more or less ferrugineous hairs. *Leaves* more or less distinctly in two rows, rather approximate, oblong or ovate-oblong to elliptic, 5–8 by  $2\frac{1}{2}$ – $4\frac{1}{2}$  mm, rounded at the base, obtuse and mucronulate, or acutish at the apex; hairy like the stem, shortly petioled or sessile. *Peduncles* at most as long as the leaves, 2–5(–10) mm, hairy like the stems, 1(–2)-flowered. Bracts linear,  $1\frac{1}{2}$ –2 mm. Pedicels shorter to longer than the calyx. *Sepals* lanceolate, acuminate,  $2\frac{1}{2}$ –3 mm, pilose. *Corolla* 6–8(–10) mm diam.

Distr. India, *Malaysia*: Anambas Isl., Madura, Philippines (Luzon).

Note. A collection from the Anambas Isl. (HENDERSON 20340) is an intermediate between *var. hirsutus* and *var. decumbens*.

*var. philippinensis* OOSTSTR. Mon. Evolv. (1934) 30.

Much resembling *var. hirsutus* in habit, but differing by the more or less imbricate leaves and by the dense, shining, sericeo-villose, fulvous indumentum. Peduncles usually very short, rarely longer, to 8 mm. *Corolla ca* 10 mm diam.

Distr. *Malaysia*: Philippines (Luzon).

*var. decumbens* (R.BR.) OOSTSTR. Mon. Evolv. (1934) 38.—*E. decumbens* R.BR. Prod. (1810) 489.—*E. lanceaeifolius* SPANOGHE, Linnaea 15 (1841) 341, *nom. nud.*—*E. gracillimus* MIQ. Fl. Ind. Bat. 2 (1857) 629.—Fig. 5.

Stems at first erect, afterwards with ascending branches, slender, 30–45 cm, appressedly and whether or not patently pilose; internodes (5–) 10–20 mm. *Leaves* lanceolate to linear, 5–20(–30) by  $1\frac{1}{2}$ – $3\frac{1}{2}$ (–5) mm, rounded to acute at the base, acute or acuminate at the apex, appressed-pilose on both sides; basal leaves sometimes broader and obtusish. *Peduncles* filiform, longer than the leaves, 15–30 mm, 1–2(–3)-flowered, appressed-pilose. Pedicels mostly longer than the calyx, filiform. Bracts linear-subulate,  $1\frac{1}{2}$ –2 mm. *Sepals* narrow-lanceolate, acuminate,  $2\frac{1}{2}$ –3 mm, villose. *Corolla* 7–8 mm diam.

Distr. S. China and Indo-China to Australia and the Pacific Islands, in *Malaysia*: N. Sumatra, Malay Peninsula, Lesser Sunda Islands (Bali, Timor, Wetar), SW.-SE. Celebes, Moluccas, Philippines (Luzon, Mindanao), New-Guinea.

Note. Transitions to *var. alsinoides* are found in E. Java (Surabaja, Grisee). Most of the collec-

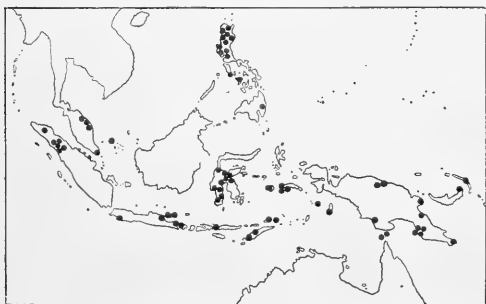


Fig. 4. *Evolvulus alsinoides* (L.) L. Distribution in Malaysia.

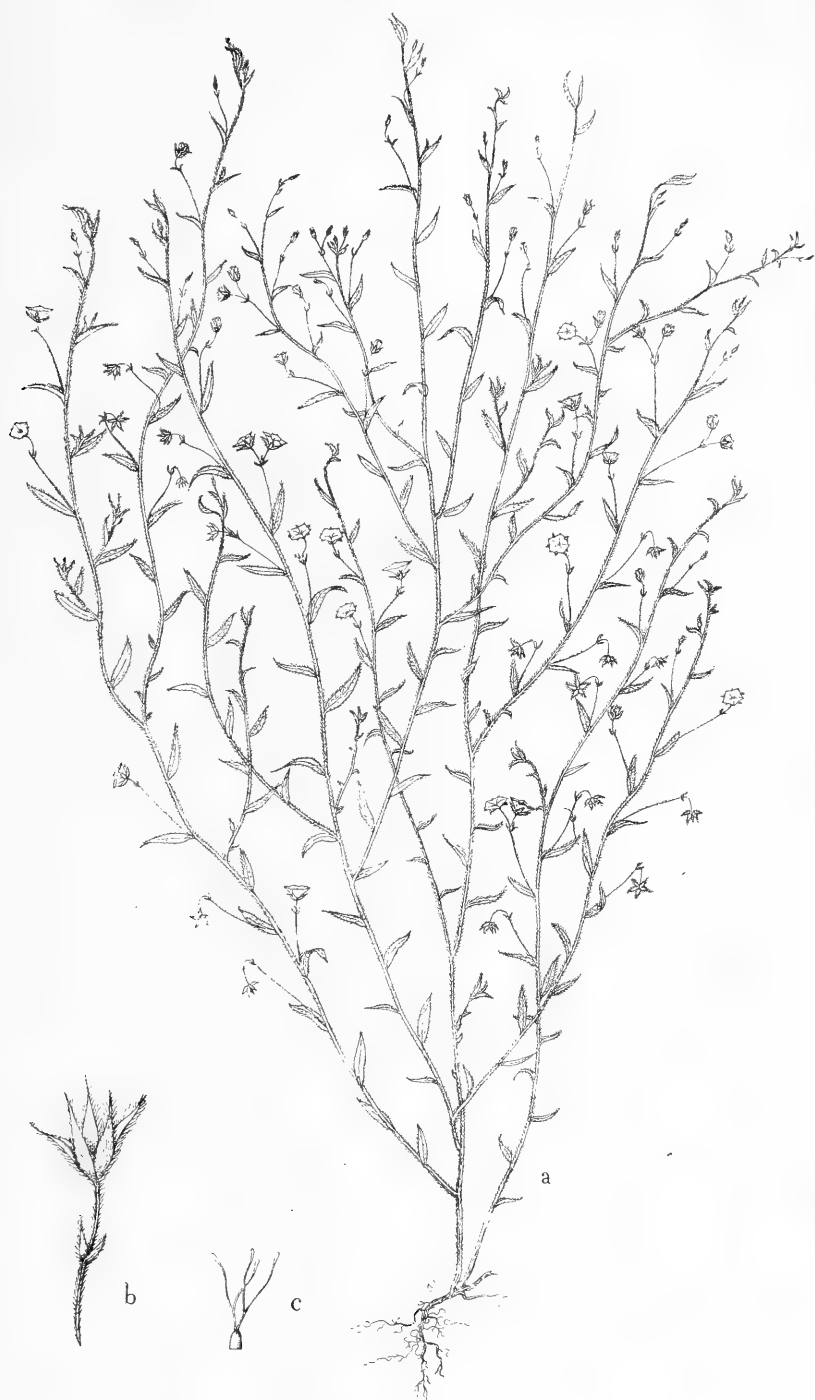


Fig. 5. *Evolvulus alsinoides* (L.) L. var. *decumbens* (R.Br.) OOSTSTR. a. Habit,  $\times \frac{1}{2}$ , b. calyx, c. pistil (b-c enlarged).

tions from the Philippines are transitions to *var. javanicus*; these plants are usually stiffer than typical *var. decumbens* and the indumentum is more shining and more or less fulvous.

*var. javanicus* (BL.) OOSTSTR. Mon. Evolv. (1934) 39.—*E. javanicus* BL. Bijdr. (1825) 724.

Stems several, erect or ascending, rather stiff, 6–20 cm, densely appressed-pilose, with fulvous, afterwards greyish, more or less shining hairs. Internodes 3–5 mm. *Leaves* linear or linear-lanceolate, 4–12 by 1–2½ mm, erect or erectopatent, attenuate towards the base, acute or acuminate at the apex, densely appressed-pilose like the stems. *Peduncles* short, 2–5 mm, pilose like the stems. *Pedicels* as long as or usually much longer than the calyx, to 7 mm. *Bracts* subulate, 1 mm. *Sepals* lanceolate, acuminate, 2½–3 mm, appressed-pilose. *Corolla* 8–9 mm diam.

Distr. *Malaysia*: Lesser Sunda Islands (Timor, Wetar), Moluccas (exact locality unknown).

Notes. The type of *E. javanicus* BL. was described from Mt Gedeh (W. Java) by BLUME. It is

fully identical with specimens of REINWARDT'S collection from the Moluccas, and as it is impossible that it has been collected on Mt Gedeh, an erroneous labelling has apparently taken place.

In the Philippines transitions to *var. decumbens* are found (see there).

*var. sericeus* BTH. Fl. Austr. 4 (1869) 438; OOSTSTR. Mon. Evolv. (1934) 40.—*E. argenteus* R.BR. Prod. (1810) 489.

Stems several, ascending, 10–20(–45) cm, densely sericeo-villose with appressed and spreading whitish or fulvous hairs. *Leaves* oblong-lanceolate, 8–20 by 3–8 mm, acutish or rounded at the base, acute or obtusish at the apex, subsessile, hairy like the stems, sometimes nearly woolly. *Peduncles* rather stout, 7–15(–25) mm, hairy like the stems, 1(–2)-flowered. *Pedicels* as long as or longer than the calyx. *Bracts* linear-subulate, 1½–2 mm. *Sepals* lanceolate, acuminate, 2½–3 mm, hairy like the other parts of the plant. *Corolla* 8–9 mm diam.

Distr. Queensland, in *Malaysia*: NE. New Guinea (once collected).

#### 4. BONAMIA

THOU. Hist. Vég. Isl. France, etc. 1 (1804) 33, t. 8, *nom. cons.*; in Dict. Sc. Nat. 5 (1805–6) 145; *non Bonamy* NECK. 1790; HALLIER f. Bull. Herb. Boiss. 5 (1897) 804, 996; OOSTSTR. Blumea 3 (1938) 75.—*Breweria* R.BR. Prod. (1810) 487.—*Trichantha* KARST. & TRIANA, Linnaea 28 (1856) 437, *non* HOOK. 1844.—Fig. 6.

Herbaceous or woody twiners, or erect undershrubs. *Leaves* petioled, lanceolate, ovate or elliptic, entire, herbaceous or rarely subcoriaceous. *Flowers* axillary, solitary, or in cymes which sometimes form terminal panicles. *Bracts* mostly small. *Sepals* 5, equal or subequal, rarely very unequal, orbicular to lanceolate, coriaceous or herbaceous. *Corolla* regular, small or medium-sized, campanulate or funnel-shaped, blue or white, with hairy midpetaline bands outside; limb 5-lobed. *Stamens* and styles included, very rarely slightly exserted; filaments adnate to the corollatube, glandular-pilose, or glabrous; pollen smooth. Disk small or none. *Ovary* 2-celled, each cell with 2 ovules; style filiform, bifid, or 2 free styles, often unequal in length, rarely 1 style; stigmas 2, globose or peltate, rarely 2-partite, or stigmas 4. *Capsule* globose or ovoid, 2-celled, 2-, 4- or 8-valved. Seeds 4 or less, glabrous or pilose.

Distr. *Ca* 40 species, widely distributed in the tropics of both hemispheres, in *Malaysia* only one species.

1. *Bonamia semidigyna* (ROXB.) HALLIER f. Bot. Jahrb. 16 (1893) 528; OOSTSTR. Blumea 3 (1938) 76.—*Convolvulus semidigynus* ROXB. (Hort. Beng. 1814, 13, *nom. nud.*) Fl. Ind. ed. CAREY & WALL. 2 (1824) 47.—*Breweria cordata* BL. Bijdr. (1825) 722.—*Breweria roxburghii* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 493.—Fig. 6.

1. *Corolla* 4½–5 cm long. Outer sepals less acuminate, often with more distinct nerves. Not so densely tomentose, but covered with short closely appressed paler hairs, especially the stems making the impression of being farinose. Finer nervation of the leaves often more visible by the absence of a dense haircloth.

*var. farinacea*

*var. semidigyna*.—Fig. 6.

Stems twining, to 15 m, terete, densely brown or reddish brown tomentose. *Leaves* broad- to narrow-ovate, 6½–15 by 4–10 cm, broadly cordate or rarely truncate at the base, shortly acuminate to cuspidate at the apex, with an acute or obtusish, mucronulate acumen, tomentose on both sides,

#### KEY TO THE VARIETIES

1. *Corolla* 3–4 cm long, rarely longer. Outer sepals acute to acuminate. Stems and lower leaf-surface with a dense brown or reddish brown tomentum. Finer nervation of the leaves indistinct . . . . . *var. semidigyna*

below more densely and more softly than above, the upper surface glabrescent, at last sometimes glabrous; lateral nerves 5-6 on either side of the midrib; petiole 18-35(-60) mm, tomentose like the stem. *Peduncles* axillary, terete or more or less applanate at the apex, variable in length, 4-14 cm, tomentose. *Flowers* in a 2-5-flowered umbelliform cyme. *Pedicels* variable in length,

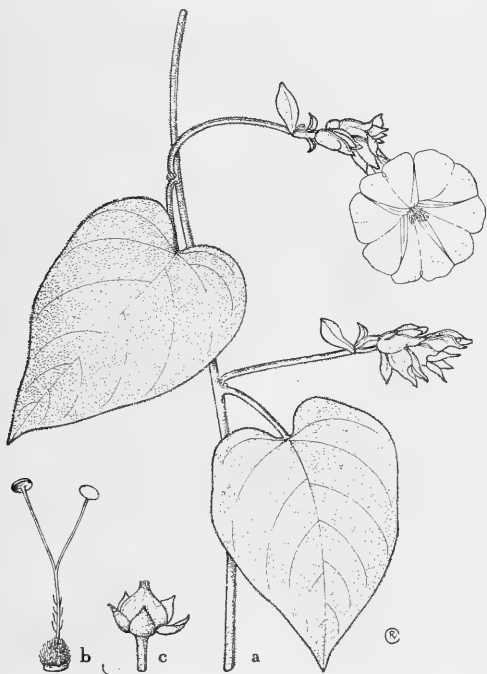


Fig. 6. *Bonamia semidigyna* (ROXB.) HALLIER f. a. Flowering branch of *var. semidigyna*,  $\times \frac{1}{2}$ , b. pistil,  $\times 1\frac{1}{2}$ , c. capsule,  $\times \frac{1}{2}$ .

4-15 mm, short-tomentose. Bracts at the base of the primary branches of the cyme small, or larger and leaf-like, and then to 2 cm long. *Sepals* about equal in length or the inner ones a little shorter, 8-14 mm long, short-tomentose; two outer sepals ovate or ovate-oblong, mostly with a waved or reflexed margin; three inner ones broadly ovate, all acute to acuminate, herbaceous, the inner ones with narrow scarious margins. *Corolla* campanulate to funnel-shaped, 3-4(-5) cm long, white, often bluish in dry specimens, midpetaline bands pilose outside, otherwise glabrous, inside glabrous or with a few hairs below the base of the filaments. Filaments sparsely pilose near the base; anthers directed downwards. Ovary hairy; style bifid, with a few hairs near the base; stigmas globose-peltate. *Capsule* broad-ovoid to subglobose, ca 12 mm high, hairy at the apex, 2-celled, 4-valved, the valves longitudinally splitting into several narrow segments, which are often connate at the top. Seeds 4, glabrous, black,  $5\frac{1}{2}$ -6 mm long, with 1 convex and 2 plane sides.

*Distr.* Madagascar, India, Indo-China, Siam,

in *Malaysia*: ?Sumatra, Malay Peninsula, W. Java, Borneo (Sarawak), SW. Celebes, Philippines (Culion).

*Ecol.* Edges of secondary forests, thickets, hedges, waysides, riverbanks, from sea-level to ca 250 m, rarely up to 600 m.

*Vern.* *Aroj balu*, S.

*Note.* The location of the two specimens collected by KORTHALS in Sumatra appears doubtful.

Besides the typical form HALLIER f. distinguished two varieties, *var. farinacea* and *var. ambigua*, mainly on account of differences in the indumentum. Full descriptions of these varieties, drafted by HALLIER after living materials in the Botanic Garden at Bogor, Java, may be found in Bull. Herb. Boiss. 5(1897) 817-818.

*var. farinacea* HALLIER f. Versl. 's Lands Pl.-tuin Btzg 1895 (1896) 125; Bull. Herb. Boiss. 5 (1897) 818, 1013; OOSTSTR. Blumea 3 (1938) 79.—*Leptostomia bancana* MIQ. Fl. Ind. Bat. Suppl. (1861) 561.

Not so densely tomentose as *var. semidigyna*, but covered with short closely appressed hairs of a paler colour, changing from brown into grey; especially the stems making the impression of being farinose. Finer nervation of the sometimes narrower leaves often much more visible by the absence of a dense haircloth. *Sepals* often somewhat shorter than in *var. semidigyna*, less acuminate, often with more distinct nerves. *Corolla* longer,  $4\frac{1}{2}$ -5 cm.

*Distr. Malaysia*: Banka, SW. Celebes, Moluccas (Ceram), S. Neth. New Guinea (Merauke).

*Ecol.* In thickets on the beach and on rocks, in marshy but also in very dry localities, between sea-level and 75 m.

*Vern.* *Akar lambai puti*, Lepar Isl., *tamber kaleleng*, Celebes, *weawè*, New Guinea.

*Note.* The only specimen collected in Ceram, KORNASSI (exp. RUTTEN) 1274, in Herb. Bogor, Leiden & Utrecht, and a specimen from Celebes, Bonto Parang, RACHMAT (exp. VAN VUUREN) 4, in Herb. Bogor & Leiden, are more or less aberrant; the Ceram plant is characterized by its long pedicels (to 20, or occasionally to 30 mm long), much longer than is generally found; the RACHMAT specimen has the sepals of an aberrant shape; they are not at all acuminate, but are elliptic and obtuse. These plants might be of importance systematically and phytogeographically when more materials should be available and when the aberrant characters should prove to be constant.

*var. ambigua* HALLIER f. Bull. Herb. Boiss. 5 (1897) 817; OOSTSTR. Blumea 3 (1938) 80.

Concerning this variety can be stated, that the specimens of it in the Leiden herbarium, all collected by HALLIER in the Botanical Garden of Bogor from one plant, fully agree with HALLIER's fine description. It is, however, more difficult to draw a satisfactory line between *var. semidigyna* and this variety, than with *var. farinacea*. It is not impossible that HALLIER is right that we have here a hybrid before us.



## 5. NEUROPELTIS

WALL. in ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 43; OOSTSTR. *Blumea* 3 (1938) 80; *ibid.* 5 (1942) 268.—Fig. 7.

Large woody twiners. *Leaves* petioled, elliptic, ovate or oblong, penninerved, entire, chartaceous or coriaceous. *Flowers* small, in rusty brown tomentose racemes, the racemes axillary or subpaniculate towards the ends of the branches. Bracts initially small, adnate to the pedicel, in fruit much accrescent, broadly elliptic to orbicular, scarious, reticulately nerved, bearing the calyx with capsule near its centre. Bracteoles minute, hairy. *Sepals* 5, subequal, suborbicular, hardly enlarged in fruit. *Corolla* regular, rotate to broadly campanulate, white, or reddish, deeply 5-lobed, the lobes induplicate-valvate in bud. *Stamens* 5, adnate to the corolla-tube, exserted or included; filaments filiform, glabrous or hairy at the base; pollen smooth. *Ovary* hairy, perfectly or imperfectly 2-celled, 4-ovuled; styles 2, free, short, each with a peltate, lobed or kidney-shaped stigma. *Capsule* small, glabrous, 1-celled, 4-valved. Seed 1, globose, smooth, glabrous, dull black.

Distr. A small genus of ca 11 species, ca 7 of which in W. tropical Africa from Upper Guinea to Portuguese Congo; and 4 in tropical Asia on the West Coast of India (Kanara, Malabar), and in SE. Asia from Siam, Tenasserim, Indo-China, and Hainan to *Malaysia*: Malay Peninsula, Borneo.

## KEY TO THE SPECIES

- |  |                       |
|--|-----------------------|
| 1. Corolla-tube inside hairy at the base of the filaments. Styles as long as or shorter than the breadth of a stigma | 1. <i>N. racemosa</i> |
| 1. Corolla-tube inside glabrous at the base of the filaments. Styles much longer than the breadth of a stigma        | 2. <i>N. maingayi</i> |

1. *Neuropeltis racemosa* WALL. in ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 44; OOSTSTR. *Blumea* 3 (1938) 81; *ibid.* 5 (1942) 269, f. 1-2, a-b.—Fig. 7 a-c.

A large woody twiner. Young branches more or less tomentellous with rusty brown hairs, the adult ones glabrous. *Leaves* elliptic or narrow-elliptic, sometimes elliptic-oblong, 6-12 by 2-7 cm, acute at the base or shortly attenuate into the petiole, acute or shortly acuminate at the apex, with a blunt, mucronulate top, coriaceous, glabrous above and beneath, or with a few scattered appressed hairs; lateral nerves 7-10 on either side of the midrib, finer reticulate nervation distinctly visible above; petiole ca 10-15 mm long or slightly longer. *Inflorescences* from the leaf-axils or from defoliate branches, racemose, solitary or 2-4 together, brown-tomentose, shorter than the leaves, 3-6 cm long or slightly longer; pedicels 2-2½ mm. Bract immediately below the sepals, ovate to ovate-lanceolate, with a distinct mucro, 2-3 mm long, in fruit broad-elliptic to orbicular, slightly emarginate and mucronulate at the apex, slightly emarginate or obtuse at the base, glabrous, except along the pedicel and sometimes along the nerves, 3-4½(-6) cm long. Two outer *sepals* orbicular or slightly broader than long, 2-2¼ mm long, three inner ones broader than long, 1¾-2 mm long. *Corolla* broadly campanulate, ca 5 mm long, deeply 5-lobed, lobes longer than the tube, with incurved, obtuse top, pilose outside. *Ovary* ovate; stigmas ca 1 mm broad. *Capsule* subglobose, ca 3½-5 mm high.

Distr. Hainan, Siam, Tenasserim, in *Malaysia*:

NW. Malay Peninsula (P. Penang, Kedah), SE. Borneo (once collected).

Vern. *Akar semting semang*, Penang, *perot ayam*, Kedah, *akar oran merah*, *akar china putih*, Mal. Pen.

2. *Neuropeltis maingayi* PETER ex OOSTSTR. *Blumea* 3 (1938) 83; OOSTSTR. *ibid.* 5 (1942) 270, f. 1-2, c-d.—Fig. 7 d-f.

A large, woody twiner, to 9 m high. Young branches rusty-tomentellous, the adult ones glabrous. *Leaves* elliptic to narrow-elliptic, 6-13 by 2½-7 cm, acute or obtuse at the base, short- to long acuminate at the apex with an acute or obtusish, mucronate to subulate top, coriaceous, sometimes more or less bullate, glabrous or nearly so above, and with few scattered appressed hairs beneath, glabrescent, or tomentose (in *var. tomentosa*). Lateral nerves 6-9 on either side of the midrib, the finer nervation not so distinctly visible above as in *N. racemosa*; petiole 10-13(-22) mm long. *Inflorescences* from the leaf-axils, one or few from an axil, racemose, or sometimes ramified and then paniculate, brown-tomentose, 3-13 cm long. Pedicels to 3 mm. Bract immediately below the sepals, ovate to ovate-lanceolate, with a distinct mucro, ca 3-4½ mm long, in fruit broad-elliptic, obtuse or emarginate and mucronulate at the apex, slightly cordate at the base, ca 4-4½ cm long. *Sepals* 2-2½ mm long; 2 outer ones orbicular, the 3 inner broader than long. *Corolla* broadly campanulate to rotate, ca 5-6½ mm long, red, white with a red tinge, or white, deeply 5-lobed, lobes longer than the tube, with more or less



Fig. 7. a-c. *Neuropeltis racemosa* WALL. a. Flowering branch,  $\times \frac{2}{3}$ , b. corolla-lobes from inside,  $\times 4$ , c. pistil,  $\times 4$ .—d-f. *N. maingayi* PETER ex OOSTSTR. d. corolla-lobes from inside,  $\times 4$ , e. pistil,  $\times 4$ , f. capsule with bract,  $\times \frac{2}{3}$ .

incurved, obtuse top, pilose outside. Ovary globose; styles *ca* 1 $\frac{1}{4}$  mm long, stigmas  $\frac{1}{2}$ – $\frac{3}{4}$  mm wide. *Capsule* ovoid, *ca* 6 mm high.

Distr. *Malaysia*: Malay Peninsula (Perak, Selangor, Malacca).

Ecol. In forests, from 30 to 240 m.

Vern. *Bungah jonkal, akar oran merah*, Malacca.

Note. The corolla is dark red or white with a

red tinge in typical specimens; in a specimen of *var. tomentosa* it is mentioned as white.

*var. tomentosa* OOSTSTR. *Blumea* 3 (1938) 85; *ibid.* 5 (1942) 270.

Leaves densely rufous or ferrugineous-tomentose beneath.

Distr. *Malaysia*: Malay Peninsula (Malacca, Pahang).

## 6. PORANA

BURM. *f.* Fl. Ind. (1768) 51, t. 21\*, f. 1; OOSTSTR. *Blumea* 3 (1938) 85.—**Fig. 8–10.**

Large woody or herbaceous twiners. *Leaves* petioled, ovate, mostly cordate at the base and palmately nerved, rarely penninerved, entire, herbaceous. *Inflorescences* racemose or paniculate, rarely flowers solitary. Bracts leaf-like, or minute and subulate, or none. *Sepals* 5, small in flower, the 3 outer ones or all in fruit much accrescent, scarious, reticulately veined, spreading, often spatulate, falling off with the fruit. *Corolla* regular, white, small, campanulate or funnel-shaped, rarely larger and funnel- or salver-shaped; limb subentire or 5-lobed. Stamens and style included, rarely exserted. *Stamens* 5; filaments adnate to the corolla, filiform, glabrous, or glandular or pubescent at the base; pollen smooth. Disk annular or none. *Ovary* mostly glabrous, 1-celled, 2-ovuled, or 1–2-celled, 4-ovuled; style 1, simple, or bifid with unequal branches; stigma globose or 2-lobed, solitary, or one on each branch. *Capsule* small, subglobose to oblong, 2-valved, or indehiscent. Seed usually 1, glabrous.

Distr. More than 20 *spp.*, for the greater part in tropical and subtropical Asia, *ca* 3 *spp.* in Africa and adjacent islands, one in Australia, and perhaps one in America.

Note. PETER subdivided the genus into three sections.

1. *Euporana* PETER (in E. & P. Nat. Pfl. Fam. 4, 3a, 1891, 24) with a bifid style, a 5-lobed funnel-shaped or campanulate corolla and the flowers in panicles; this section is represented in Malaysia by *P. volubilis* BURM. *f.*

2. *Duperreya* (GAUD.) PETER *l.c.* 24, with an entire style, solitary funnel-shaped or campanulate flowers and narrow leaves; not in Malaysia.

3. *Dinetus* (BUCH.-HAM.) PETER *l.c.* 25, with an entire style, funnel- or salver-shaped flowers, several-flowered inflorescences and cordate leaves; represented in Malaysia by *P. racemosa* ROXB., the often cultivated *P. paniculata* ROXB. and by *P. spectabilis* KURZ.

### KEY TO THE SPECIES

- |  |                          |
|--|--------------------------|
| 1. Corolla <i>ca</i> 2 $\frac{1}{2}$ cm long . . . . .   | 4. <i>P. spectabilis</i> |
| 1. Corolla up to 1 cm long.  |                          |
| 2. Style bifid to about the middle. Stamens exserted. All sepals enlarged in fruit . . . . .   | 1. <i>P. volubilis</i>   |
| 2. Style entire. Stamens included. All sepals or only 3 enlarged in fruit.   |                          |
| 3. Style very short, as long as or shorter than the ovary. Corolla shallowly lobed or subentire. Stamens inserted in the corolla-tube at about the same height. Three sepals enlarged in fruit . . . . . | 3. <i>P. paniculata</i>  |
| 3. Style longer than the ovary. Corolla deeply 5-lobed. Stamens inserted at different height in the corolla-tube. All sepals enlarged in fruit . . . . .   | 2. <i>P. racemosa</i>    |

1. *Porana volubilis* BURM. *f.* Fl. Ind. (1768) 51, t. 21\*, f. 1; OOSTSTR. *Blumea* 3 (1938) 87.—*P. volubilis* BURM. *f.* *var. burmanniana* BL. Bijdr. (1825) 723.—*P. volubilis* BURM. *f.* *var. microcarpa* ENGL. Bot. Jahrb. 7 (1886) 472.—**Fig. 8–9.**

A large woody twiner, up to 20 m high; stems to 1 or 2 cm thick; adult branches pale brown or grey, often minutely verrucose; young parts pilose. *Leaves* ovate, 3–9 by 2–6 cm, mostly broadly rounded or slightly cordate at the base, acuminate at the apex, with an obtuse, or slightly

emarginate acumen; glabrous or sparsely hairy, often shining above, pinnately nerved, with 5–7 nerves on either side of the midrib; petiole much shorter than the blade, 1–3 cm, glabrous or hairy. *Flowers* fragrant, often in dense lateral and terminal inflorescences, forming large, broad panicles, which are leafy below. Peduncles and pedicels pilose; pedicels *ca* 3–5 mm. *Sepals* oblong to obovate, obtuse, *ca* 4–5 mm long, glabrous except apex and base, or sparsely pilose on the whole surface, all enlarged in fruit, oblong to spatulate



Fig. 8. *Porana volubilis* BURM. f. Cultivated at Bogor.

late, or obovate, 7–10 mm long, with 7–8 stronger longitudinal nerves. *Corolla* deeply 5-lobed, 8–10 mm long, white, glabrous or short-pilose; lobes obtuse, spreading. Stamens exserted, very unequal; filaments much longer than the anthers, inserted near the corolla-base. Ovary glabrous; style bifid with unequal branches; stigmas globose. *Capsule* broad-ovoid to globose, 3–4 mm long, mucronulate, glabrous. Seed 1, ovoid, ca 2–2½ mm long, purple-brown or black, minutely verrucose.

*Distr.* Burma and Indo-China to *Malaysia*: N. Sumatra, Java, Kangean Islands, Lesser Sunda Islands (Bali, Lombok, Sumbawa, Timor), Borneo, Celebes, Philippines (Luzon), Moluccas (Ambon), probably cultivated in the Bismarck Archipelago; also cultivated in India and Siam, the Malay Peninsula and elsewhere in *Malaysia*.

*Ecol.* Thickets, edges of forests, teak-forests, from sea-level to ca 200 m, occasionally higher, in Timor up to 750 m. In Java mainly in parts with a pronounced dry season.

*Uses.* Cultivated in gardens for ornamental purposes. A decoction of the plant is used in stimulating the afterbirth. The leaves represent one of the ingredients used in pressing *djambu bagolan* in the Principalities where they are also eaten to remove a nasty taste from the mouth.

*Vern.* Kěmbang pēngantén, M, widosari, bidasari, widasantun, plilitan, angkeb, arus arusan, J, bidhasarè, Md, widosari, bila sarè, Kangean, bunga nasi, Ambon, nuit or nuif, Timor, akar lapat, N. Borneo; Philippines: kalabonog, kamuras, Ilk.; bridal wreath, white corallina, E., schildersverdriet, bruidsbloemen, witte bruidstranen, D.

2. *Porana racemosa* ROXB. (Hort. Beng. 1814, 13, *nom. nud.*) Fl. Ind. ed. CAREY & WALL. 2 (1824) 41; OOSTSTR. *Blumea* 3 (1938) 91.—*P. elegans* ZOLL. Nat. Geneesk. Arch. 2 (1845) 571.

Stems twining, herbaceous, up to 10 m high, terete, in youth more or less hirsute, afterwards minutely verrucose, or glabrous. *Leaves* ovate, 2½–10 by 2½–7 cm, deeply cordate at the base, acuminate to caudate at the apex, with a blunt or acute acumen; appressed-pilose on both sides, beneath more densely than above; rarely pubescent to tomentose; palmately nerved with 7(–9) nerves from the base; petiole shorter than or as long as the blade, pilose to glabrous. *Inflorescences* paniculate, axillary, more or less widely branched, few- or many-flowered. Lower bracts leaf-like, sessile or shortly petioled, stem-clasping, glabrous or pilose; upper bracts subulate. Pedicels much longer than the sepals, 3–6, later to 10 mm long, glabrous or pilose. *Sepals* equal, linear-lanceolate, 1½–2½ mm long, sparsely pilose, all enlarged in fruit, linear-oblongate, obtuse and mucronulate at the apex, attenuate towards the base, up to 18 mm long, but often shorter, with 3 stronger longitudinal nerves, sparsely pilose, especially near the base. *Corolla* 5-lobed to the middle, ca 1 cm long, white with yellowish tube, glabrous; lobes spreading, rounded. Stamens included; filaments shorter than the anthers, inserted at different height in the corolla-tube. Ovary glabrous; style 1, entire, longer than the ovary; stigma clavate, 2-lobed. *Capsule* ovoid, 7–8 mm high,



Fig. 9. *Porana volubilis* BURM. f. a. Fruiting branch,  $\times 1/2$ ; b. fruit with sepals, nat. size, c. pistil.

mucronate, glabrous. Seed 1, ovoid, to 6 mm long, brownish-black to black, smooth.

Distr. SE. Asia to S. China, and *Malaysia*: Malay Peninsula (only cultivated), Java, Lesser Sunda Islands (Bali, Lombok, Sumbawa, Timor), SW. Celebes.

Ecol. Thickets, edges of secondary forests, waysides, from 400 to 1800 m, both in regions with and without a dry season.

Vern. *Tjunglar*, *tjunlar*, *tjunlu*, *rendeng*, *srintil*, *J*, *kioke*, Md, *snow-creeper*, *E*, *molentjes*, *D*.

**3. *Porana paniculata* ROXB.** Pl. Corom. 3 (1819) 31; OOSTSTR. *Blumea* 3 (1938) 93.—**Fig. 10.**

A large woody twiner with greyish tomentellous, almost downy stems. *Leaves* ovate, 4–9 by 2½–6 cm, cordate at the base, obtuse, acute, acuminate or shortly cuspidate at the apex, hairy on both surfaces, palmately nerved with 5–7 nerves from the base; nerves prominent beneath; petiole ½–2½ cm. *Inflorescences* lateral or terminal, paniculate. Flowers smaller than in the preceding species, numerous. *Sepals* linear, ca 1–1½ mm long, densely tomentellous; three of them much enlarged in fruit. *Corolla* funnel-shaped, 5–6 mm long, white, the limb shallowly lobed to crenate. Stamens included; filaments about equal in length, as long as the anthers or a little shorter, inserted near the corolla-base at about the same height. Style 1, entire, as long as or shorter than the ovary; stigma globose, lobed. Capsule ovoid-globular, ca 5 mm diam.

Distr. N. India to Upper Burma; cultivated as an ornamental in *Malaysia* and elsewhere in the tropics, occasionally run wild.

Uses. Commonly cultivated in gardens for its dense masses of white flowers; never fruiting in *Malaysia*.

Vern. *Kembang garen*, *M*, *bridal creeper*, *E*, *schildersverdriet*, *D*.

**4. *Porana spectabilis* KURZ,** J. Bot. 11 (1873) 136; For. Fl. Burma 2 (1877) 221; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 221; KERR, Fl. Siam. En. 3, 1 (1951) 92.

A large woody twiner; branches fulvous-tomentose. *Leaves* ovate-oblong, up to 10 by 4½–5 cm, rounded or shallowly cordate at the base, acute or obtusish at the apex, densely puberulous, especially beneath; petiole 1½–2½ cm. *Flowers* in lax racemes terminating axillary rather short branchlets. Pedicels ca 5–7 mm. *Sepals* linear-oblong, ca 5 mm long, fulvous-tomentose; 3 of them enlarged in fruit, 3½–4 cm long, oblong, obtuse, puberulous, 5-nerved at the base. *Corolla* widely funnel-shaped, nearly 2½ cm long, white, puberulous outside; limb subentire. Style entire, long,



Fig. 10. *Porana paniculata* ROXB. a. Flowering branch,  $\times \frac{1}{3}$ , b. flower,  $\times 3$ , c. pistil.

filiform; stigma subcapitate. Capsule subglobose, ca ½ cm diam.

Distr. Assam, Burma, Indo-China, and *Malaysia*: Malay Peninsula (Perak), once collected.

Note. The above description is for a considerable part derived from the literature, as the only Malaysian specimen (CURTIS s.n. in herb. Sing.) unfortunately is no longer at hand.

## 7. ERYCIBE<sup>1</sup>

ROXB. Pl. Corom. 2 (1798) 31, t. 159; CHOISY, Ann. Sc. Nat. II, 1 (1834) 220; G. DON, Gen. Syst. 4 (1838) 392; DC. Prod. 9 (1845) 463; B. & H. Gen. Pl. 2

(1) By R. D. HOOGLAND.

(1876) 868; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 180; PRAIN, J. As. Soc. Beng. 63,2 (1894) 83; *ibid.* 65,2 (1896) 536; HALLIER f. Bull. Herb. Boiss. 5 (1897) 736; PRAIN, J. As. Soc. Beng. 73,2 (1904) 14; *ibid.* 74,2 (1906) 287. — *Fissipetalum* MERR. J. Str. Br. R. As. Soc. 85 (1922) 168; SLEUM. Pfl. Fam. ed. 2, 16b (1935) 32; *ibid.* 20b (1942) 392; AIRY SHAW, Kew Bull. (1947) 22.—Fig. 11–18.

Woody climbers or creepers, sometimes straggling shrubs, rarely small trees. Older branches with orbicular to oval lenticels or with longitudinal cork-ridges. *Leaves* simple, entire, often more or less acuminate at apex; midrib distinctly prominent beneath, nerves and venation otherwise variable. Petiole short, channelled above, usually with some low longitudinal ridges and many small rather sharp transverse ridges. *Inflorescences* terminal or axillary, paniculate, rarely flowers solitary. Bracts usually minute, caducous. *Flowers* fragrant. Pedicel usually with 2, sometimes fewer or more, minute caducous bracteoles. *Sepals* 5, free, usually hairy outside except along in bud covered margins which are glabrous or at least distinctly less hairy for some breadth, allways glabrous inside, 2 outer sepals generally different in shape from 2 inner ones, third sepal for one side agreeing with 2 outer ones, for other side with 2 inner ones. *Corolla* deeply 5-lobed, tube glabrous outside, each lobe (petal) with about triangular, outside hairy, midpetaline field, and 2 lateral lobules, glabrous, rather thin, with distinct, mainly longitudinal venation, to rather thick, with indistinct venation (in dried specimens), rarely club-shaped; corolla glabrous inside except in 2. *E. praecipua*. *Stamens* 5, inserted slightly above corolla-base, with short, about triangular or laterally concave filament; anther usually obtuse to acuminate at apex, cordate at base, sometimes truncate to retuse at both ends. Pollen smooth. *Ovary* about ellipsoid, glabrous or partly to completely hairy, 1-celled, with 4 (rarely in a casual flower 5) basal ovules; stigma usually about conical, attached to the ovary in the centre for small diameter, usually with 5 or 10 longitudinal, straight, or slightly contorted ridges, rarely crown-like, funnel-shaped in centre above, attached to the ovary for nearly the whole diameter of the latter. *Fruit* a berry, generally little fleshy, ellipsoid or, rarely, obpyriform, glabrous, smooth or scurfy, or hairy; one-seeded; seed with plain or strongly folded cotyledons.

Distr. S. Japan (Yakushima), Riu-kiu Islands, Formosa, S. China, Indo-China, Siam, Burma, India, Ceylon, throughout *Malaysia*, and N. Queensland; in New Caledonia probably only introduced; erroneously reported from Micronesia. Fig. 17.

Ecol. In scrub or forests, from low altitude up to ca 1300 m altitude.

An ecologically interesting species of this genus is 12. *E. stenophylla* which belongs to the rheophytes, i.e. plants which are confined to (mostly) gravelly or rocky beds of streams subject to sudden floods. The narrow, often falcate, leaf-shape of the species confined to this remarkable ecological niche is characteristic and *E. stenophylla* perfectly fits into this group.

Another ecologically interesting species is the cauli- and ramiflorous 7. *E. ramiflora*, the single species of the genus showing this feature.

Uses. The branches are sometimes used for binding purposes; medicinal use is unimportant.

Notes. HALLIER f. (1897) subdivided the genus into 2 series, *Rimosae* and *Tereticaules*, mainly on account of the structure of the bark (with longitudinal cork-ridges in *Rimosae*, with lenticels in *Tereticaules*). In a great number of the species this character is clear and constant, in some species, however, it is difficult to decide to which of the two groups they belong; where necessary these species have been inserted in the key twice. In some species the bark is not known from branches of sufficient age. It is possible that an extensive anatomical analysis will provide a more reliable basis for these two groups. A remarkable feature is that the species in *Rimosae* are consistently hairy or glabrous as regards the ovary, whereas this character is not constant in several of the species belonging to the *Tereticaules*.

The *Tereticaules* are subdivided by HALLIER f. into 2 groups on account of the venation on the lower surface of the leaves. In the *Venulosae* the leaves are reticulately veined beneath, in the *Fibrosae* they

are rugulose by sclerotic fibres, rarely remotely reticulately veined beneath. The venation may, indeed, be a reliable character for identification, though not in *Tereticuales* only.

A character which I have used but which has not been used previously for specific distinction in *Erycibe* is the structure of the hairs, particularly those from the calyx and the midpetaline fields. The indumentum of the vegetative parts agrees with that of the calyx, though the dimensions may be slightly different. The two main types distinguished are 1) 2-branched hairs, and 2) 3- to many-branched hairs (stellate hairs). In the species with 2-branched hairs a 3-branched one may be found incidentally, similarly a 2-branched hair in some species with stellate hairs. There may be a short common trunk, which is, however, found only in few species with 2-branched hairs. Among the stellate hairs again 2 types can be distinguished: all branches may be of about the same length, or there may be one branch which is distinctly longer and stronger than the others. In some species with hairs of the latter type the difference between the branches is only slight; if necessary these species have been inserted twice in the key. If hairs of the type with one stronger branch are found on the midpetaline field, there is always a rather small number of hairs with subequal branches, mainly along the lateral margins of this field.

Most species are fairly constant in their general features, others are extremely variable (e.g. 45. *E. malaccensis* and 20. *E. terminaliflora*). Though in some cases the characters used in the key may hardly seem to warrant specific distinction of separate species, the accepted species have often a marked and constant habit by which they are easily distinguished in the herbarium, though it is extremely difficult to describe this habit clearly.

*Erycibe paniculata* Roxb. has been reported from many parts of the area of the genus. The genuine *E. paniculata* is found only in India.

#### KEY TO THE SPECIES<sup>1</sup>

1. Anthers truncate or retuse at the apex; greatest breadth of anther at or above the middle.
2. Stigma funnel-shaped in the centre above, 5-lobed at the margin, attached to the ovary for nearly the whole diameter of the latter.
3. Corolla glabrous inside. Lateral nerves and venation distinctly prominent on both sides. Anthers about as long as broad . . . . . 1. *E. sapotacea*
3. Corolla locally hirsute inside. Lateral nerves and venation hardly distinct to slightly sunken on both sides. Anthers longer than broad, at the base narrower than at the apex . . . . . 2. *E. praecipua*
2. Stigma more or less conical or low-cylindric, flat or conical at the apex, often with 5 or 10 longitudinal ridges, narrowly attached to the ovary in the centre.
4. Sepals sparsely strigose outside. Pedicel ca 7–15 mm long, with bracteoles inserted in the lower part. Venation invisible or faintly distinct on both sides . . . . . 3. *E. pedicellata*
4. Sepals densely strigose or hirsute outside. Pedicel up to ca 7 mm long; bracteoles inserted immediately below the flower. Venation generally distinct on both sides.
5. Sepals outside with about equal numbers of 2- and 3-branched, up to 700  $\mu$  long hairs. Midpetaline field with 2–5-branched, up to 900  $\mu$  long hairs. Corolla ca 7 mm long . . . . . 4. *E. griffithii*
5. Sepals outside with predominantly 2-branched, up to 400  $\mu$  long hairs. Midpetaline field with 2- (and few 3-) branched, up to 600  $\mu$  long hairs. Corolla ca 5½–6 mm long. . . . . 5. *E. micrantha*
1. Anthers acute to obtuse, rarely slightly truncate at apex; greatest breadth of the anther always distinctly below the middle.
6. Lobules of the corolla club-shaped, ca 1 mm thick (cf. fig. 15).
7. Sepals ca 5–6 mm long, outside with up to 1500  $\mu$  long hairs. Ovary densely hirsute. Leaves 12–15-nerved, elliptic to obovate, bullate, glabrous above, rather densely villose-hirsute beneath. . . . . 6. *E. magnifica*
7. Sepals ca 2½–3 mm long, outside with up to 350  $\mu$  long stellate hairs. Ovary nearly glabrous. Leaves 4–8-nerved, obovate-oblong to oblong, more densely hairy above than beneath. . . . . 7. *E. ramiflora*
6. Lobules of the corolla membranous or fleshy, much thinner.
8. Sepals completely glabrous outside.
9. Lobules of the corolla about as long as broad or slightly longer, without distinct venation.
10. Ovary completely glabrous. Leaves 5–8-nerved, purplish when dry. Pedicel 2½–4 mm long. Midpetaline field with 2- and 3-branched hairs, branches up to 150, rarely 250  $\mu$  long. . . . . 8. *E. sargentii*
10. Ovary hirsute in upper part. Leaves 4–6-nerved, dark brown when dry. Pedicel 7–10 mm long. Midpetaline field with 2-branched hairs, branches up to 450  $\mu$  long . . . . . 9. *E. sumatrensis*
9. Lobules of corolla twice as long as broad, with distinct, mainly longitudinal venation.
11. Younger branches strigose (with 2-branched hairs), very soon glabrescent. Midpetaline field with generally 2-, few 3-branched hairs . . . . . 10. *E. albidia*
11. Younger branches short-hirsute (with 3–9-branched, stellate hairs), very soon glabrescent. Midpetaline field with 3–9-branched hairs.

(1) Flowers of 51. *E. impressa* from Borneo, 52. *E. induta*, and 53. *E. zippelii* both from New Guinea, are unknown.

12. Hairs of midpetaline field 4-9-branched with subequal, up to 250  $\mu$  long branches.  
12. Hairs of midpetaline field 3-8-branched, partly with subequal, up to 250  $\mu$  long branches, for the greater part with one stronger, up to 500  $\mu$  long branch . . . . . 30. *E. crassipes*
8. Sepals sparsely to densely strigose or stellate-hirsute outside. . . . . 36. *E. borneensis*
13. Flowers all solitary, axillary. Leaves ovate to lanceolate, *ca* 1 $\frac{1}{2}$ -5 $\frac{1}{2}$  by 1-2 cm. . . . . 11. *E. leucoxyloides*
13. Flowers in terminal and/or axillary panicles, rarely an incidental solitary flower. Leaves larger. . . . . 12. *E. stenophylla*
14. Leaves linear-lanceolate, about 8-10  $\times$  as long as broad . . . . . 12. *E. stenophylla*
14. Leaves broader, up to at most 4  $\times$  as long as broad. . . . . 12. *E. stenophylla*
15. Sepals outside with predominantly or exclusively 2-branched hairs. . . . . 12. *E. stenophylla*
16. Leaves rather sparsely to densely appressed-hairy beneath on intervenium, nerves, and midrib; indumentum long-persistent. . . . . 12. *E. stenophylla*
17. Inflorescences *ca* 6-10-flowered, with *ca*  $\frac{1}{2}$ -1 cm long axis. Leaves densely sericeous beneath . . . . . 13. *E. sericea*
17. Inflorescences many- (10-80)-flowered, with *ca* 2-20 cm long axis. . . . . 13. *E. sericea*
18. Leaves rather sparsely long and thinly strigose beneath . . . . . 14. *E. strigosa*
18. Leaves densely short-strigose beneath with subsistent indumentum . . . . . 15. *E. subsericea*
16. Leaves glabrous beneath or at most with rather sparse (rarely rather dense) soon caducous indumentum mainly on midrib and nerves. . . . . 15. *E. subsericea*
19. Midpetaline field with predominantly 3-branched, few 2- and 4-branched hairs. . . . . 15. *E. subsericea*
20. Anthers obtuse, slightly truncate at apex. Hairs of calyx up to 900  $\mu$  long, generally with distinct basal trunk,  $\pm$  distant, indumentum thereby hirsutish . . . . . 16. *E. kinabaluensis*
20. Anthers acuminate at apex. Hairs of calyx up to 450  $\mu$  long, without distinct basal trunk, appressed, indumentum thereby strigose . . . . . 17. *E. maingayi*
19. Midpetaline field with predominantly 2-branched hairs, very few or no 3-branched ones. . . . . 17. *E. maingayi*
21. Ovary hirsute, at least partly. . . . . 17. *E. maingayi*
22. Older branches terete, with orbicular lenticels. . . . . 17. *E. maingayi*
23. Intervenium rugulose, venation generally indistinct beneath. Inflorescences axillary, rather short (up to 5 cm, up to 50-flowered) . . . . . 18. *E. coriacea*
23. Intervenium smooth, venation generally more or less prominent beneath. . . . . 18. *E. coriacea*
24. Inflorescences axillary, short (up to 5 cm, up to 15-flowered) . . . . . 19. *E. festiva*
24. Inflorescences terminal and axillary, longer (*ca* 4-25 cm, 10-125-flowered). . . . . 19. *E. festiva*
25. Leaves 8-12-nerved, about 4 $\frac{1}{2}$ -10 by 2-4 $\frac{1}{2}$  cm . . . . . 20. *E. terminaliflora*
25. Leaves 5-7-nerved, about 9-15 by 5 $\frac{1}{2}$ -9 cm . . . . . 15. *E. subsericea*
22. Older branches with distinct longitudinal cork-ridges. . . . . 15. *E. subsericea*
26. Ovary glabrous in the lower, hairy in the upper part. Lobules of corolla about as long as broad . . . . . 21. *E. hollrungii*
26. Ovary hairy over the whole surface. Lobules of corolla distinctly longer than broad. . . . . 22. *E. ramosii*
21. Ovary glabrous. . . . . 22. *E. ramosii*
27. Older branches terete, with orbicular lenticels. . . . . 22. *E. ramosii*
28. Inflorescences axillary and terminal, (2 $\frac{1}{2}$ -)4-25 cm, 10-125-flowered. Lobules of the corolla not or hardly longer than broad. . . . . 20. *E. terminaliflora*
28. Inflorescences axillary, up to 1 $\frac{1}{2}$  cm (casually up to 3 cm), (1-)-2-10-flowered. Lobules of the corolla distinctly longer than broad . . . . . 23. *E. glomerata*
27. Older branches with distinct longitudinal cork-ridges. . . . . 23. *E. glomerata*
29. Inflorescences axillary, up to 1 $\frac{1}{2}$ , rarely an incidental one up to 3 cm long, (1-)-2-10-flowered . . . . . 23. *E. glomerata*
29. Inflorescences axillary, sometimes also terminal, (1 $\frac{1}{2}$ -)3-25 cm long, (5-)-15-125-flowered. . . . . 23. *E. glomerata*
30. Nerves and venation faintly to distinctly sunken above; nerves faintly prominent to faintly sunken, venation sunken beneath. Intervenium rugulose beneath. Leaves thick-coriaceous . . . . . 24. *E. elliptimba*
30. Nerves and venation faintly to distinctly prominent on both sides, rarely nerves faintly sunken above. . . . . 24. *E. elliptimba*
31. Axillary inflorescences 30-100-flowered, (3-)-8-18 cm. Leaves *ca* 12-19 by 5-10 cm. Corolla 5 $\frac{1}{2}$ -6 mm long . . . . . 25. *E. floribunda*
31. Axillary inflorescences (5-)-10-30-flowered, (1 $\frac{1}{2}$ -)3-8 cm. Leaves *ca* 7-12 by 3-6 cm. Corolla 6-9 $\frac{1}{2}$  mm long . . . . . 26. *E. forbesii*
15. Sepals outside with 3-12-branched hairs, at most with a small percentage of 2-branched ones. . . . . 26. *E. forbesii*
32. Hairs of midpetaline field with subequal branches, or with some larger and some smaller branches, at most a casual hair with a single stronger and longer branch. . . . . 26. *E. forbesii*
33. Venation sunken beneath. Inflorescences *ca* 20-200-flowered . . . . . 27. *E. grandifolia*
33. Venation more or less prominent, rarely indistinct (then inflorescences few-flowered) beneath. . . . . 27. *E. grandifolia*



34. Leaves rather densely hairy with long-persistent indumentum on whole surface beneath; leaves up to *ca* 8 by  $3\frac{1}{2}$  cm . . . . . **28. E. carrii**
34. Leaves glabrous beneath or with soon caducous indumentum; if the indumentum is rather long persistent, the leaves are much larger or the indumentum is persistent along the midrib and nerves only.
35. Ovary completely glabrous.
36. Leaves elliptic-oblong to oblong (*ca*  $2-2\frac{1}{2} \times$  as long as broad), bullate, when young densely hirsute along the midrib and nerves beneath. Hairs of the calyx and corolla with 250–500  $\mu$  long branches . . . . . **29. E. bullata**
36. Leaves oblong to lanceolate-oblong (*ca*  $2\frac{1}{2}-4 \times$  as long as broad), flat, practically glabrous beneath. Hairs of calyx and corolla with 150–250  $\mu$  long branches **30. E. crassipes**
35. Ovary hirsute, at least the extreme apical part, usually for the upper  $\frac{1}{3}$  part to the whole surface.
37. Ovary hirsute for the whole surface. . . . . **31. E. nitidula**
37. Ovary hirsute for the upper part only, glabrous for the lower part.
38. Hairs of the midpetaline field 2–5-branched, the 2-branched ones well represented, up to 1000  $\mu$  long . . . . . **32. E. papuana**
38. Hairs of the midpetaline field 4–8-branched, 2-branched ones completely absent.
39. Leaves rather large, *ca*  $6\frac{1}{2}-15$  by  $2\frac{1}{2}-6$  cm, more or less bullate. Species from the Malay Peninsula . . . . . **33. E. stapfiana**
39. Leaves rather small, *ca* 4–8 by  $1\frac{1}{2}-4\frac{1}{2}$  cm, flat. Species from E. Malaysia.
40. Anthers obtuse at apex. Indumentum beneath soon caducous. **34. E. hellwigii**
40. Anthers acute at apex. Indumentum beneath rather long persistent along midrib and nerves . . . . . **35. E. timorensis**
32. Hairs of the midpetaline field for an important (usually by far the greater) part with one branch distinctly longer (*ca*  $1\frac{1}{2} \times$  or more) and, usually, stronger than the others.
41. Older branches terete, smooth or with about orbicular lenticels, at most with very low, not-fissured, longitudinal ridges.
42. Lobules of the corolla about  $1\frac{1}{2}-2 \times$  as long as broad . . . . . **36. E. borneensis**
42. Lobules of the corolla at most about as long as broad.
43. Venation distinctly impressed beneath. Midpetaline field in upper part with hairs of which one branch is stronger, in lower part only with hairs with subequal branches. . . . . **37. E. aenea**
43. Venation slightly to distinctly prominent beneath. Hairs with one stronger branch equally distributed over the midpetaline field.
44. All sepals glabrous along their margins outside, ciliate along the whole margin. . . . . **38. E. macrophylla**
44. Sepals glabrous outside only along in bud covered margins; ciliate only along glabrous margins.
45. Calyx outside with hairs with one distinctly stronger (*ca* 500–750  $\mu$  long) branch; indumentum yellowish- to orange-brown. Inflorescences axillary, 2–20-flowered,  $\frac{1}{2}-4$  cm long. Leaves often more or less hirsute beneath. Nerves usually more or less impressed above . . . . . **39. E. citriniflora**
45. Calyx outside with equal-branched hairs (branches up to *ca* 250  $\mu$  long); indumentum purplish-brown. Inflorescences terminal or axillary, 5–200-flowered, 1–23 cm long. Leaves (except when very young) glabrous beneath. Nerves roundly raised above. . . . . **40. E. rheedii**
41. Older branches with distinct longitudinal cork-ridges, usually with longitudinal fissures along them.
46. Ovary glabrous.
47. Leaves 3–4-nerved (rarely a casual 5-nerved leaf). Sepals up to 3 mm long. Inflorescences terminal, many-flowered . . . . . **41. E. expansa**
47. Leaves 5–10-nerved, if few 4-nerved leaves present then sepals 3.8–5 mm long. Inflorescences usually axillary, rather few-flowered.
48. Lobules of corolla about  $1\frac{1}{2}-2$  times as long as broad. Two outer sepals up to  $2\frac{1}{2}$  mm long. Inflorescences clustered, without a distinct central axis . . . . . **36. E. borneensis**
48. Lobules of corolla at most slightly longer than broad. Two outer sepals  $2\frac{1}{2}-5$  mm long. Inflorescences, though often short, with a distinct central axis.
49. Sepals sparsely hirsute outside; indumentum distinctly red-tinged (in dried state). Lobules of corolla coherent above the midpetaline field for 1– $1\frac{1}{2}$  mm. **42. E. tomentosa**
49. Sepals densely hirsute outside; indumentum generally yellowish to, rarely, brownish, never red-tinged (in dried state). Lobules of corolla not or hardly coherent above midpetaline field.
50. Stigma strongly warty. Two outer sepals 3.8–5 mm long. Indumentum on lower side of leaves often rather long persistent . . . . . **43. E. grandiflora**

- 50. Stigma smooth or only slightly warty (only with 5 or 10 round longitudinal ridges). Two outer sepals 2½–4 mm long. Indumentum on lower side of leaves soon caducous.
- 51. Leaves 8–10-nerved. 2 outer sepals 2.5–2.6 mm long. Inflorescences short, 1–2 cm long. Indumentum of sepals brownish (in dried state). Anthers 2.2–2.3 mm long.
- 44. *E. beccariana*
- 51. Leaves 4–6(–7)-nerved. Two outer sepals 3–4 mm long. Inflorescences generally longer, 1½–10(–16) cm long. Indumentum of the sepals yellowish (in dried state). Anthers 1.3–1.8 mm long
- 45. *E. malaccensis*
- 46. Ovary hirsute, at least for extreme apical part, usually for the upper 1/3 part to the whole surface.
- 52. Stamens acute to obtuse at apex, without distinct sterile acumen.
- 53. Two outer sepals oval, 2 inner ones about orbicular to transverse-oval
- 34. *E. hellwigii*
- 53. All sepals broader than long, often the 2 outer ones more so than the 2 inner.
- 54. Leaves distinctly glossy above. Nerves and venation generally sunken above.
- 46. *E. clemensae*
- 54. Leaves dull, glaucous above. Nerves and venation generally prominent above.
- 35. *E. timorensis*
- 52. Stamens acuminate at apex, with distinct 0.3–0.7 mm long sterile acumen.
- 55. Ovary hairy for whole surface. Part of bracts leaf-like, up to 12 mm long
- 47. *E. schlechteri*
- 55. Ovary hairy in the upper, glabrous in the lower part. Bracts minute, up to ca 3 mm long.
- 56. Indumentum on lower side of leaves long-persistent along the midrib
- 48. *E. puberula*
- 56. Indumentum on lower side of leaves soon caducous.
- 57. Inflorescences rather many (up to ca 50)-flowered. Corolla ca 5½ mm long.
- 32. *E. papuana*
- 57. Inflorescences few (up to ca 12)-flowered. Corolla ca 8 mm long.
- 58. Larger hairs of midpetaline field mainly 2-branched, few of them 3-branched.
- 49. *E. brassii*
- 58. Larger hairs of midpetaline field (3–)4–6-branched
- 50. *E. subglabra*

1. *Erycibe sapotacea* HALLIER f. & PRAIN ex PRAIN, J. As. Soc. Beng. 73, 2 (1904) 16; *ibid.* 74, 2 (1906) 293; RIDL. Fl. Mal. Pen. 2 (1923) 447.—Fig. 11.

Scandent shrub, younger branches strigose, older ones with longitudinal cork-ridges. Leaves coriaceous, elliptic-oblong, 7–20 by 3½–10 cm, 6–10-nerved; obtuse to rounded, often short-acuminate at the apex, obtuse to rounded at the base; glabrous on both sides; with slightly sunken midrib and slightly prominent nerves above; with prominent nerves and venation beneath. Petiole 8–14 mm. Inflorescences axillary, up to 1½ cm, up to 10-flowered. Flowers known only from buds. Pedicel 1–2 mm. Sepals 1 & 2 broad-ovate, 2.7 by 3 mm, 4 & 5 transverse-oval, distinctly retuse at apex, 2.5 by 3.2 mm; rather densely strigose outside (hairs 2-branched, up to 400 µ total length). Corolla 7½ mm, tube 2½ mm; midpetaline field 3½ by ca 2 mm, densely hirsute (hairs (2–)3(–4)-branched, up to 500 µ total length); lobules 2 by 2 mm, rather thick, without distinct venation. Stamens inserted 0.7 mm above the corolla-base; filament 1.3 mm long, 0.5 mm broad at base; anther 0.7 mm long, 0.7 mm broad, 0.5 mm thick, truncate at apex and base. Ovary 2.8 by 1.7 mm, glabrous; stigma funnel-shaped, not sharply separated from the ovary, 5-lobed at the margin, the lobes decurrent as longitudinal ridges on the ovary. Fruits 1 or 2 together, axillary, on strongly thickened, up to 1½ cm long, 3–5 mm thick stalk which is partly pedicel, partly peduncle; fruit ovoid, 45 by 22 mm, acutish at the apex, rounded at the base, probably little fleshy. Cotyledons strongly folded.

Distr. Malaysia: Malay Peninsula (Penang Island).

Ecol. At 350 m altitude; fl. March, fr. March, July, and Aug.

2. *Erycibe praecipua* PRAIN, J. As. Soc. Beng. 63, 2 (1894) 86; *ibid.* 74, 2 (1906) 294; RIDL. Fl. Mal. Pen. 2 (1923) 447.—Fig. 12.

KEY TO THE SUBSPECIES

- 1. Leaves (3–)5–11 by (1½–)2½–5 cm, 4–5-nerved. Petiole 5–10 mm. Inflorescences up to 2 cm long. Pedicel 2–5 mm . . . *ssp. praecipua*
- 1. Leaves 10–15 by 4½–7½ cm, 5–7-nerved. Petiole 9–15 mm. Inflorescences up to 5 cm long. Pedicel 5–15 mm . . . *ssp. borneensis*

*ssp. praecipua*.—Fig. 12a–b.

Large climbing shrub, younger branches rather sparsely strigose, older ones with longitudinal cork-ridges. Leaves coriaceous, elliptic-oblong, (3–)5–11 by (1½–)2½–5 cm, 4–5-nerved; obtuse to rounded, often slightly acuminate at the apex, obtuse at the base; glabrous, with slightly sunken midrib and faintly prominent nerves and venation above; glabrous, with slightly prominent nerves and faintly prominent venation beneath. Petiole 5–10 mm. Inflorescences axillary, up to 2 cm, (1–)2–9-flowered. Pedicel 2–5 mm. Sepals subequal, broadly ovate or orbicular to transverse-oval, 1.8–2 by 1.9–2.5 mm, sparsely strigose outside (hairs with 2 branches, up to 300 µ total length). Corolla 7 mm, tube 1.7–2 mm; midpetaline field 3.5–3.8 by 1.6–2.2 mm, rather densely hirsute outside (hairs with 2(–4) branches, up to 400 µ total length); lobules 1.8 by 1.5 mm, with not or slightly visible venation, entire; coherent above midpetaline field for 1–1.5 mm; shortly villose-hirsute inside from 1.5 to 4 mm above the corolla-base. Stamens inserted

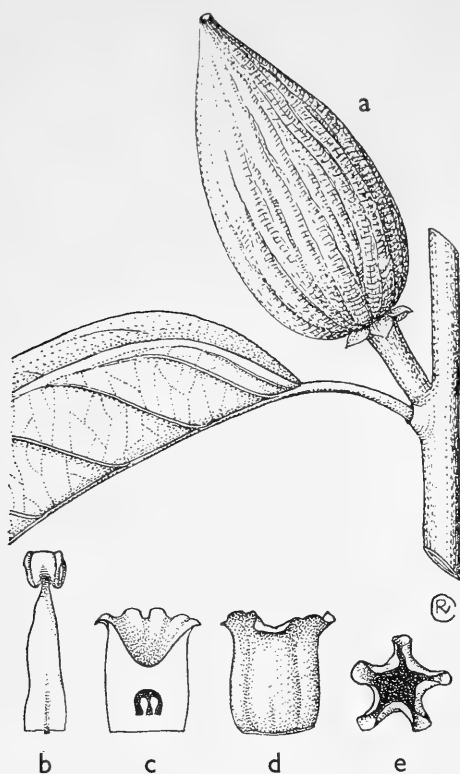


Fig. 11. *Erycibe sapotacea* HALLIER f. & PRAIN ex PRAIN. a. Fruit, nat. size, b. stamen,  $\times 10$ , c. ovary, longitudinal section,  $\times 5$ , d. ovary, lateral view,  $\times 5$ , e. stigma, from above,  $\times 5$ .

0.7–1.2 mm above the corolla-base; filament 0.3–0.4 mm long, 0.2 mm broad at the base; anther 0.7–0.8 mm long, 0.6–0.7 mm broad near the apex, 0.4–0.5 mm near the base, 0.4–0.5 mm thick, truncate at both ends. Ovary 1–1.2 by 0.9–1.2 mm, glabrous; stigma crown-like with 5- or 10-lobed margin, funnel-shaped in centre above, with 5 or 10 longitudinal ridges. Fruit ellipsoid, 18 by 12 mm, glabrous, smooth. Cotyledons strongly folded.

Distr. *Malaysia*: Malay Peninsula (Penang, Perak), at 150–600 m.

*ssp. borneensis* HOOGL. *Blumea* 7 (1953) 315.—Fig. 12c.

Differs from *ssp. praecipua* by the following characters: Liana, 30 m long; older branches at first with sharp longitudinal ridges, later on with lenticels on these ridges. Leaves 10–15 by  $4\frac{1}{2}$ – $7\frac{1}{2}$  cm, 5–7-nerved. Petiole 9–15 mm. Inflorescences up to 5 cm long. Pedicel 5–15 mm. Sepals 1 & 2 measure 2.8–3 by 2.8–3, sepals 4 & 5 are 2.7–2.8 by 2.8–3.3 mm. Corolla 8 mm; midpetaline field 4.5 by 2.8 mm, densely stellate-hirsute outside (hairs with 3–7 subequal up to 250  $\mu$  long branches); lobules 2–2.5 by 1.5–2 mm. Stamens in-

serted 1.5 mm above the corolla-base; filament 0.5 mm long, 0.3 mm broad at the base; anther 1.2 mm long. Ovary 1.5 mm through.

Distr. *Malaysia*: Borneo (Kinabalu), once collected, at 1200 m.

3. *Erycibe pedicellata* RIDL. ex HOOGL. *Blumea* 7 (1953) 315.

Scandent shrub, younger branches sparsely strigose, older ones with distinct longitudinal cork-ridges. Leaves coriaceous, oblong, 6–12 by 2– $4\frac{1}{2}$  cm, 4–6-nerved; obtuse to rounded, often slightly acuminate at the apex, obtuse at the base; glabrous except very sparsely strigose, soon glabrescent midrib on both sides; with slightly sunken midrib, faintly prominent nerves and hardly distinct venation above; with faintly prominent nerves and hardly distinct venation beneath. Petiole 7–12 mm. Inflorescences axillary, about fasciculate, up to  $2\frac{1}{2}$  cm, (1–)2–5-flowered. Flowers known only from buds. Pedicel 7–15 mm. Sepals transverse-oval, 2 by  $2\frac{1}{2}$  mm, sparsely strigose outside (hairs with 2 branches, up to 500  $\mu$  total length). Corolla 6 mm, tube 2 mm; midpetaline field 2.6 by 1.8 mm, rather densely appressed-hairy (hairs with 2–4 subequal up to 450  $\mu$  long branches); lobules 2 by 1.3 mm, without distinct venation, entire. Stamens inserted 1.3 mm above the corolla-base; filament 0.3 mm long, ca 0.3 mm broad at the base; anther 0.5 mm long, 0.8 mm broad, 0.4 mm thick, truncate, slightly retuse at apex and base. Ovary 1.6 by 1 mm, glabrous; stigma conical, with 5 faint longitudinal ridges. Fruit unknown.

Distr. *Malaysia*: Borneo (Sarawak), once collected.

Note. The species resembles *E. praecipua* PRAIN *ssp. borneensis* HOOGL., from which it differs by the glabrous inner side of the corolla, the shape of the anthers (broader than long), and the conical (not funnel-shaped) stigma.

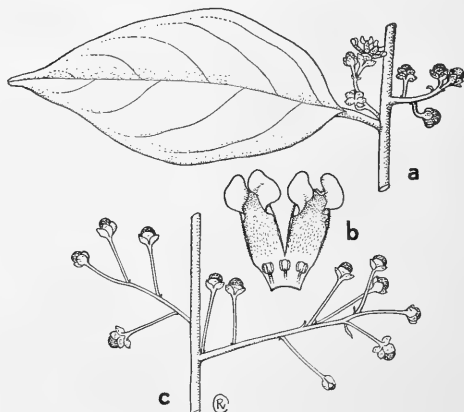


Fig. 12. *Erycibe praecipua* PRAIN. a. Flowering branch of *ssp. praecipua*,  $\times 2/3$ , b. 2 corolla-lobes from inside,  $\times 2$ , c. inflorescences of *ssp. borneensis* HOOGL.  $\times 2/3$ .

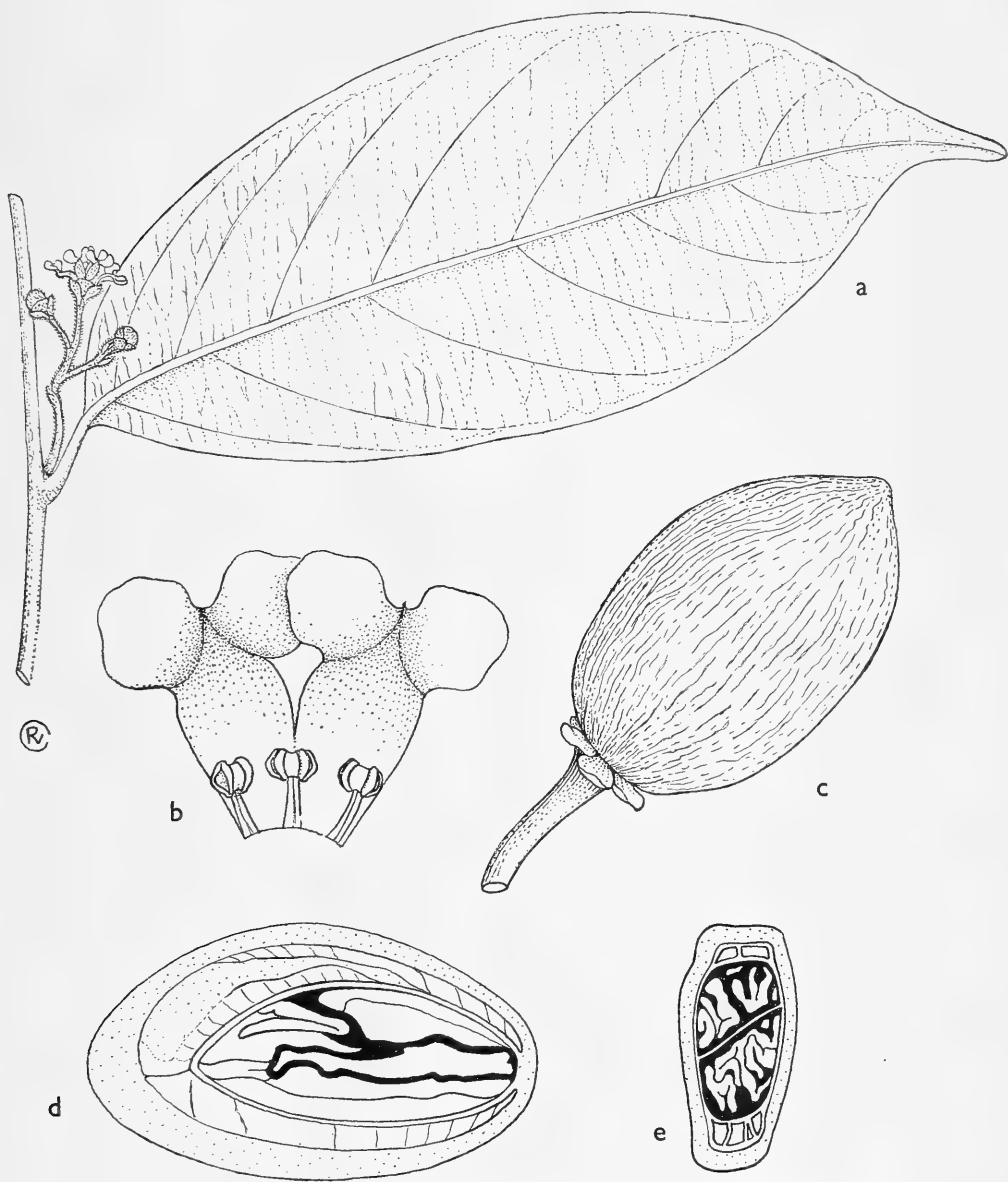


Fig. 13. *Erycibe griffithii* CLARKE. a. Flowering branch, nat. size, b. corolla-lobes from inside,  $\times 5$ , c. fruit,  $\times 1\frac{1}{2}$ , d. fruit in longitudinal, e. in transverse section,  $\times 2$ .

4. *Erycibe griffithii* CLARKE in HOOK. f. Fl.Br. Ind. 4 (1883) 182; PRAIN, J. As. Soc. Beng. 63, 2 (1894) 85; *ibid.* 74, 2 (1906) 295 p.p.; RIDL. Fl. Mal. Pen. 2 (1923) 447 p.p.; KERR, Fl. Siam. En. 3 (1951) 96.—*E. cupreum* GAGNEP. Not. Syst. 14 (1950) 27.—Fig. 13.

Scandent shrub (rarely tree?), up to 30 m long, 15 cm diam., younger branches stellate-hirsute, older ones with longitudinal ridges, often together

with small lenticels. Leaves coriaceous, elliptic to oblong, ovate-oblong, or obovate-oblong, 7–14 by  $2\frac{1}{2}$ –8 cm, 5–8-nerved; acuminate at the apex, acute to obtuse or rounded at the base; glabrous, with slightly to faintly prominent midrib, nerves, and venation above; glabrous (or sparsely stellate-hirsute near petiole, glabrescent), with distinctly prominent nerves and distinct, but usually hardly raised venation beneath. Petiole 7–14 mm. In-

*florescences* axillary, sometimes 2 or 3 together, up to  $3\frac{1}{2}$  cm, (1–)3– $\pm$ 10-flowered. Pedicel (2–)3–6(–7) mm, distinctly thickened in fruit. *Sepals* 1 & 2 broad-ovate or triangular-ovate, 2–3 by 2–3 mm, 4 & 5 transverse-oval, 2–2.8 by 2.7–4 mm, densely stellate-hirsute outside (hairs with 2–3, generally more or less curled, up to  $600\ \mu$  long branches). *Corolla* white, 7 mm, tube  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm; midpetaline field  $3\frac{1}{2}$ –4 by  $2$ – $2\frac{1}{2}$  mm, densely stellate-hirsute (hairs with 2–5 branches, in the larger hairs generally one longer, up to  $600\ \mu$  long branch); lobules 2–2.8 by 2–2.5 mm, without distinct venation, entire or slightly crenulate, coherent above midpetaline field for  $\frac{1}{2}$ –1 mm. *Stamens* inserted 1– $1\frac{1}{2}$  mm above the corolla-base; anther sessile, 0.4–0.5 mm long, 0.7–0.8 mm broad, 0.5 mm thick, slightly retuse at apex and base. *Ovary*  $1\frac{1}{2}$ –2 by  $1$ – $1\frac{1}{2}$  mm, glabrous; stigma conical, with 10 more or less distinct ridges. *Fruit* probably little fleshy, obpyriform,  $3\frac{1}{2}$  by 2 cm, scurfy outside, greyish brown when dry. Cotyledons strongly folded.

Distr. Lower Burma (Mergui), Indo-China, in Malaysia: Peninsular Siam, Malay Peninsula.

Ecol. In (primary?) forests at low altitude (in Malaysia up to 200 m), in Indo-China up to 1000 m alt. *Fl.* (Malay Peninsula) Feb.–Apr., fr. June–Oct.

Notes. *Erycibe maingayi* CLARKE was reduced to the present species by PRIN and RIDLEY. It is, however, specifically distinct, though habitually resembling the present species.

The species is closely related to *E. micrantha* HALLIER f., which has also been reduced to it in recent times; cf. under that species.

5. *Erycibe micrantha* HALLIER f. Bot. Jahrb. 16 (1893) 524.—*E. griffithii* (non CLARKE) MERR. En. Philip. 3 (1923) 358.—*E. lateralisflora* ELM. Leaf. Philip. Bot. 5 (1913) 1767; MERR. Philip. J.Sc. Bot. 11 (1917) 309.—*E. javanica* K. & V. Bijdr. Booms. Java 13 (1914) 37; OOSTSTR. in BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 191, 9.

Climber, up to 16 m high, 10 cm diam., younger branches densely strigose, older ones with low cork-ridges, sometimes together with small orbicular lenticels. *Leaves* subcoriaceous, elliptic to oblong, ovate-oblong, or obovate-oblong,  $7$ – $12\frac{1}{2}$  (–20) by  $2\frac{1}{2}$ –6(–10) cm, 6–9-nerved; slightly to distinctly acuminate at the apex, obtuse to rounded at the base; sparsely strigose, very soon glabrescent, with slightly prominent midrib and nerves and faintly raised venation above; sparsely strigose, very soon glabrescent, with prominent nerves and faintly prominent venation beneath. Petiole 7–10(–14) mm. *Inflorescences* axillary, sometimes 2 together, 2–4 cm, 5–10(–15)-flowered. Pedicel 2–7 mm, thickened in fruit. *Sepals* 1 & 2 broadly ovate or triangular-ovate, 1.7–2.2 by 1.8–1.9 mm, 4 & 5 transverse-oval, 1.6–2 by 2.4–3 mm, rather densely strigose outside (hairs with 2 branches, up to  $450\ \mu$  total length). *Corolla*  $5\frac{1}{2}$ –6 mm, tube  $1\frac{1}{2}$  mm; midpetaline field 2.5–3 by 1.7–2 mm, densely appressed-hairy (hairs mainly with 2, few with 3–4 branches, up to  $750\ \mu$  total length);

lobules 1.5–2 by 1.7–2.2 mm, with nearly invisible venation, entire or faintly crenulate at margin, coherent above midpetaline field for  $\frac{1}{2}$  mm. *Stamens* inserted  $1$ – $1\frac{1}{2}$  mm above the corolla base; anther nearly sessile, 0.4–0.5 mm long, 0.7–0.8 mm broad, 0.5–0.6 mm thick, slightly retuse at apex and base. *Ovary* 1.2–1.5 by 0.8–1 mm glabrous or with few appressed hairs in the basal central, or the upper part; stigma conical, with 5 ridges in the lower part, smooth in upper part. *Fruit* probably little fleshy, obpyriform, 22 by 14 mm, scurfy outside, yellow (once noted) when fresh, greyish brown when dry. Cotyledons strongly folded.

Distr. Malaysia: Sumatra, Java, Borneo, Philippines, Moluccas (local in all these islands).

Ecol. In forests up to 800 m.

Vern. *Alor ilisawali* (Simalur).

Notes. The ovary is hairy except in ELMER 12750 (type of *E. lateralisflora* ELM.) from the Philippines and DIEPENHORST 3692 from Sumatra which possess glabrous ovaries.

Except by the characters given in the key, the present species differs from the closely related *E. griffithii* CLARKE in the generally laxer inflorescences and the flowers, which are smaller in all parts. The differences are slight, but in view of the general constancy of the characters of the hairs on calyx and corolla it is for the present retained as a species.

6. *Erycibe magnifica* PRIN, J. As. Soc. Beng. 73, 2 (1904) 18; *ibid.* 74, 2 (1906) 289; RIDL. Fl. Mal. Pen. 2 (1923) 445.

Strong and slender creeper or climber, up to 35 m long, stem up to  $7\frac{1}{2}$  cm diam., younger branches densely stellate-hirsute, older ones with low cork-ridges and without or with few oval lenticels. *Leaves* rigidly coriaceous, elliptic to obovate, 9–23 by  $5$ – $12\frac{1}{2}$  cm, 12–15-nerved; rounded at the apex, obtuse to rounded, somewhat cordate at the base, with recurved margin; glabrous, with sunken midrib, nerves, and venation above; rather densely villose-hirsute, with slightly raised nerves and slightly sunken to faintly raised venation beneath. Petiole 7–12 mm. *Inflorescences* axillary, sometimes 2–4 together, up to 4 cm, up to 12-flowered. Pedicel 3–5 mm. *Sepals* 1 & 2 broadly ovate, 6 by  $6\frac{1}{2}$  mm, 4 & 5 transverse-oval, 5 by 6 mm; densely stellate-hirsute outside (hairs with long and strong, up to  $1500\ \mu$  long, central branch and 2–5 small, up to  $100\ \mu$  long, basal branches). *Corolla* dark yellow, 10 mm, tube 4 mm; midpetaline field 6 by 4 mm, densely appressed-hairy (hairs with long and strong, up to  $2000\ \mu$  long, central branch and 1–3 small, up to  $50\ \mu$  long, basal branches). Lobules club-shaped,  $2\frac{1}{2}$  by 2 mm, near the apex 1.4 mm broad and 1 mm thick. *Stamens* inserted  $2\frac{1}{2}$  mm above the corolla-base; filament  $\frac{1}{2}$  mm long, 0.8 mm broad at the base; anther 0.8 mm long, 0.9 mm broad, 0.5 mm thick, obtuse at the apex, slightly cordate at the base. *Ovary* 1 by  $1\frac{1}{2}$  mm, densely hirsute; stigma conical, warty over the whole surface, with 5 faint ridges. *Fruit* flattened-ellipsoid, 29 by 24 by 19

mm, densely hirsute with up to 2 mm long hairs. Cotyledons plain.

Distr. *Malaysia*: Malay Peninsula (Perak), rare.

Ecol. In open or dense jungle at 250 m.

**7. *Erycibe ramiflora* HALLIER f.** Ann. Jard. Bot. Btzg 14 (1897) 352, *nomen semi-nudum*; Bull. Herb. Boiss. 5 (1897) 743.—*E. cauliflora* HALLIER f. ex COSTERUS & J. J. S. Ann. Jard. Bot. Btzg 19 (1904) 160, t. 23 f. 68 (teratology), *sphalm.*—Fig. 14–15.

Subarborescent, trunk up to 12 cm diam., younger branches stellate-hirsute, older ones with large transverse lenticels. *Leaves* thick, rigidly coriaceous, obovate-oblong to oblong, 6–14 by 3–6 cm, 4–8-nerved; slightly acuminate at the apex, acute to obtuse (or rounded) at the base; densely stellate-hirsute, soon glabrescent, with slightly prominent midrib and nerves and faintly prominent to indistinct venation above; less densely stellate-hirsute, soon glabrescent, with slightly prominent nerves and faintly prominent to indistinct venation beneath. Petiole 3–5 mm. *Inflorescences*

terminal, in basal part leafy, axillary, or cauline. Pedicel 2–4 mm; bracteoles up to 3 mm long. *Sepals* 1 & 2 broadly ovate, 2.3–2.5 by 3.2–3.3 mm, 4 & 5 transverse-oval, 2.5–2.8 by 3–3.5 mm, stellate-hirsute outside (hairs with 3–5 subequal, up to 350  $\mu$  long branches). *Corolla* pale yellowish, 7½–8 mm, tube 2 mm; midpetaline field 5 by 3 mm, densely appressed-hairy (hairs with strong, up to 1000  $\mu$  long central branch and 1–3 small, up to 150  $\mu$  long basal branches); lobules club-shaped, 2.5 by 1.7 mm, near the apex 1 mm broad and thick. *Stamens* inserted 1 mm above the corolla-base; filament 0.3 mm long, 0.6 mm broad at the base; anther 1 mm long, 0.7 mm broad, 0.4 mm thick, acuminate (sterile acumen 0.3 mm) at the apex, slightly cordate at the base. *Ovary* 1.2 by 0.7 mm, glabrous except few hairs immediately below the stigma; stigma conical, warty, without distinct ridges. *Fruit* unknown.

Distr. *Malaysia*: Sumatra (E. Coast), known only from a TEYSMANN-collection, since cultivated at Bogor.

Note. The species is strongly characterized by the shape and peculiar position of the lobules of the corolla, which are found also in *E. magnifica* PRAIN. The present species is the only one in the genus from which typically cauline inflorescences are known.

**8. *Erycibe sargentii* MERR.** Philip. J.Sc. Bot. 13 (1918) 56; En. Philip. 3 (1923) 359.

Large scandent shrub, branches glabrous, older ones with many lenticels. *Leaves* coriaceous, oblong, 6–18 by 2½–8 cm, 5–8-nerved; acute to acuminate at the apex, acute to obtuse or rounded at the base; glabrous on both sides; with slightly sunken midrib, slightly prominent to faintly sunken nerves, and faintly prominent to indistinct venation above; with slightly prominent nerves, faintly prominent to indistinct venation beneath. Petiole 8–14 mm. *Inflorescences* terminal, in basal part sometimes with some leaves, or axillary, 2½–10 cm, 10–100-flowered. Pedicel 2½–4 mm. *Sepals* 1 & 2 orbicular, 3 by 3 mm, 4 & 5 transverse-oval, 2.7–2.8 by 3.2–3.9 mm, glabrous outside. *Corolla* white or pale yellowish, 12–12.5 mm, tube 2–3 mm; midpetaline field 7–7.5 by 3.5–3.8 mm, densely appressed-hairy (hairs with 2–3(–4) subequal up to 250  $\mu$  long branches); lobules 5–6.5 by 5–6 mm, without distinct venation, entire or slightly undulate at margin. *Stamens* inserted 1–1.5 mm above the corolla-base; filament 0.8–1 mm long, 0.8–0.9 mm broad at the base; anther 2.5–2.8 mm long, 0.9–1 mm broad, 0.5–0.6 mm thick, acuminate (sterile acumen 1 mm) at the apex, cordate at the base. *Ovary* 2–2.5 by 1.6–1.8 mm, glabrous; stigma conical, with 10 distinct ridges. *Fruit* ellipsoid, 2 by 1.5 cm, glabrous, smooth.

Distr. *Malaysia*: Philippines (Luzon, Panay, and Mindanao).

Ecol. On forested slopes at low altitude; fl. Feb.–May.

Note. Practically glabrous; few short (up to 200  $\mu$  long) 2-branched hairs are found on the



Fig. 14. *Erycibe ramiflora* HALLIER f. Cultivated specimen in the Botanic Gardens, Bogor (H. HALLIER).

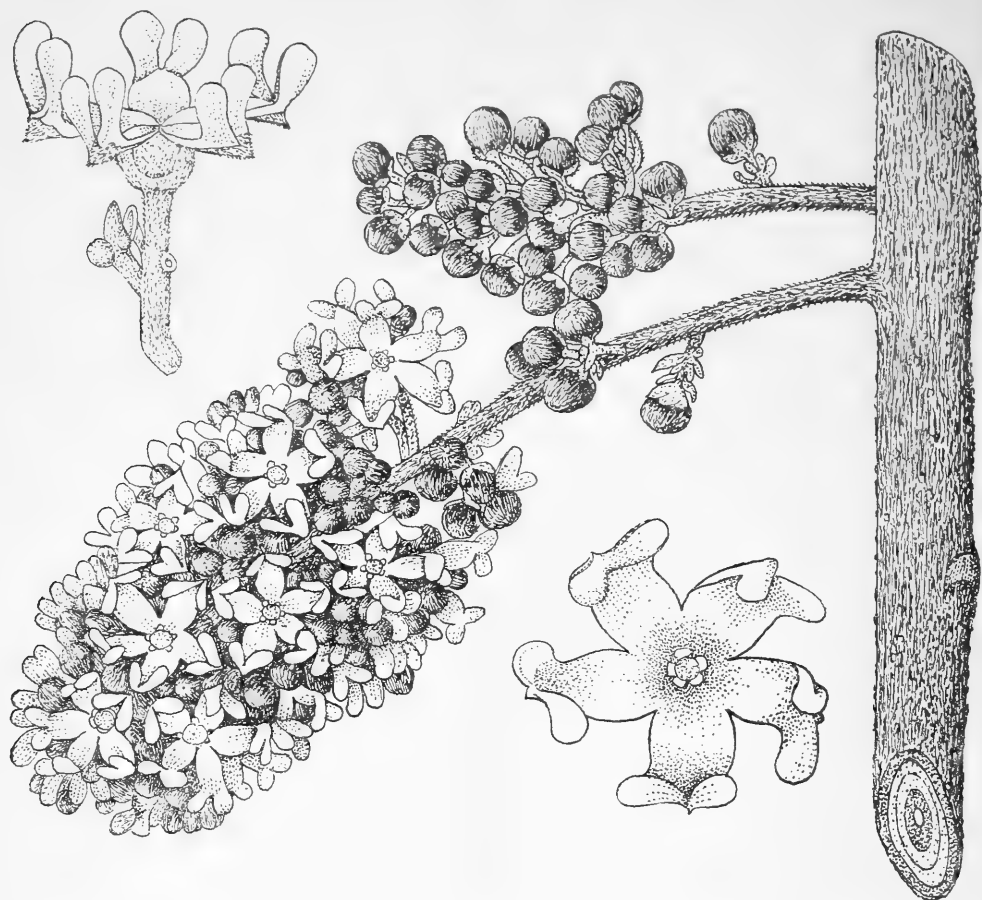


Fig. 15. *Erycibe ramiflora* HALLIER f. Cauline inflorescences and lateral and apical view of flowers, resp.  $\times 1\frac{1}{2}$  and  $\times 3$ .

branches of the inflorescences and on the basal part of the pedicels only. The indumentum of the midpetaline field is, however, rather dense.

**9. *Erycibe sumatrensis* MERR.** Pap. Mich. Acad. Sc. 19 (1934) 190.

Scandent shrub, branches sparsely strigose, older ones terete, with many lenticels. *Leaves* subcoriaceous, oblong, 8–12½ by 2½–5 cm, 4–6-nerved; acuminate at the apex, acute (to obtuse) at the base; glabrous, with slightly sunken midrib, slightly prominent nerves, and faintly prominent venation above; glabrous, with slightly prominent nerves, and faintly prominent venation beneath. *Petiole* 10–20 mm. *Inflorescences* axillary, 3–9 cm, 3–25-flowered. Flowers fragrant. *Pedicel* 7–10 mm. *Sepals* 1 & 2 broad-ovate, 3 by 3.2–3.5 mm, 4 & 5 transverse-oval, 3 by 3.8–4 mm, glabrous outside. *Corolla* white, 12–14 mm, tube 3 mm; midpetaline field 6–8 by 3–4 mm, densely appressed-hairy (hairs 2-branched, up to 600  $\mu$  total length); lobules 5–6 by 4–5 mm, rather

thick, without distinct venation, slightly crenate at margin. *Stamens* inserted 1.7 mm above the corolla-base; filament 0.7 mm long, 0.5 mm broad at the base; anther 1.6 mm long, 0.8–0.9 mm broad, 0.6 mm thick, acuminate (sterile acumen 0.6 mm) at the apex, slightly cordate at the base. *Ovary* 1.4 by 0.8–1.3 mm, glabrous in the lower 0.8 mm, hairy in the upper part; stigma conical, with 5 distinct ridges. Fruit unknown.

*Distr. Malaysia:* Sumatra (Asahan), once collected.

*Ecol.* Edge of swamp forest.

**10. *Erycibe albid*a** PRAIN, J. As. Soc. Beng. 63, 2 (1894) 87.—*E. glomerata* (non BL.) PRAIN, J. As. Soc. Beng. 74, 2 (1906) 294; RIDL, Fl. Mal. Pen. 2 (1923) 447; KERR, Fl. Siam. En. 3 (1951) 94.—*E. glomerata* var. *typica* PRAIN, J. As. Soc. Beng. 74, 2 (1906) 294.—*E. glomerata* var. *longifolia* (non BL.) PRAIN, J. As. Soc. Beng. 74, 2 (1906) 295; RIDL, Fl. Mal. Pen. 2 (1923) 448.

Shrub or small tree, up to 6 m by 7½ cm.

Branches strigose, older ones with faint longitudinal ridges and few oval lenticels. *Leaves* subcoriaceous, narrowly oblong to oblong or oblanceolate, (9-)14-22(-40) by (3-)4<sup>1</sup>/<sub>2</sub>-8(-12<sup>1</sup>/<sub>2</sub>) cm, 8-12 (-16)-nerved; acute, generally slightly acuminate at the apex, obtuse to broadly acute at the base; glabrous, with sunken midrib, faintly prominent nerves and major venation, and indistinct minor venation above; glabrous with slightly prominent nerves and indistinct venation beneath. Petiole (5-)10-15(-20) mm. *Inflorescences* axillary, up to 1 cm long, (1-)2-4(-10)-flowered. Pedicel 1-3 mm, with rather broad bracteoles. *Sepals* 1 & 2 orbicular, 2-3<sup>1</sup>/<sub>2</sub> by 2-3<sup>1</sup>/<sub>2</sub> mm, 4 & 5 transverse-oval, 2.2-3<sup>1</sup>/<sub>2</sub> by 2<sup>1</sup>/<sub>2</sub>-4 mm, glabrous outside. *Corolla* white, 12-14 mm, tube 2-4.5 mm; midpetaline field 4.5-5 by 1.8-2 mm, rather densely appressed-hairy (hairs 2-, few 3-branched, up to 600  $\mu$  total length); lobules 5<sup>1</sup>/<sub>2</sub>-6 by 3-3<sup>1</sup>/<sub>2</sub> mm, rather thin, with distinct venation, entire or minutely crenate-serrate at the margin, coherent above the midpetaline field for <sup>1</sup>/<sub>2</sub> mm. *Stamens* inserted 0.7-2 mm above the corolla-base; filament 1.5-1.7 mm long, 0.4-0.6 mm broad at base; anther 1.5-1.8 mm long, 0.5-0.9 mm broad, 0.4-0.6 mm thick, broadly acute at the apex, cordate at the base. *Ovary* 1.8-2.2 by 0.8-0.9 mm, glabrous; stigma conical, with 5 faint to distinct ridges. Fruit unknown.

*Distr. Malaysia:* Peninsular Siam, Malay Peninsula.

*Ecol.* In forests, up to 900 m alt., fl. Sept.-March.

*Note.* Closely related to *E. glomerata* BL., differing primarily by the completely glabrous (except the ciliate margins) sepals.

**11. *Erycibe leucoxyloides* KING ex PRAIN, J. AS. Soc. Beng. 73, 2 (1904) 16; *ibid.* 74, 2 (1906) 292; RIDL. Fl. Mal. Pen. 2 (1923) 446.**

Slender low bushy climber, younger branches stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* rather thick, ovate to lanceolate, 16-55 by 10-20 mm, 3-5-nerved; rounded-obtuse to acuminate at the apex, rounded to slightly cordate at the base; stellate-hirsute, soon glabrescent, with slightly sunken midrib and indistinct nerves and venation above; stellate-hirsute, soon glabrescent, with faintly prominent to indistinct nerves and indistinct venation beneath. Petiole 1<sup>1</sup>/<sub>2</sub>-6 mm. *Flowers* solitary, axillary. Pedicel 2-4 mm with ca 5-10 bracteoles; bracteoles oval (upper ones), 2<sup>1</sup>/<sub>2</sub> by 2 mm, to lanceolate (lower ones), 2<sup>1</sup>/<sub>2</sub> by 0.8 mm. *Sepals* subequal, broadly ovate to orbicular, 3 by 3.3 mm, rather thin, sparsely stellate-hirsute (hairs with 4-5 subequal up to 250  $\mu$  long branches), glabrous along all margins outside. *Corolla* 8 mm, tube 3 mm; midpetaline field 3 by 1<sup>1</sup>/<sub>2</sub> mm, rather densely appressed-hairy (hairs with (2-)3-5(-6) branches, one stronger and longer up to 1000  $\mu$  long); lobules 3<sup>1</sup>/<sub>2</sub> by 3 mm, rather thin, with distinct venation, entire. *Stamens* inserted 0.3 mm above the corolla-base; filament 0.7 mm long, 0.3 mm broad at the base; anther 1.2 mm long, 0.5 mm

broad, 0.3 mm thick, acuminate (sterile acumen 0.2 mm) at the apex, slightly cordate at the base. *Ovary* 0.9 by 0.7 mm, glabrous; stigma conical, with 5 longitudinal ridges. *Fruit* ellipsoid, 1<sup>1</sup>/<sub>2</sub> by 1 cm, glabrous, smooth, green. Cotyledons plain.

*Distr. Malaysia:* Malay Peninsula.

*Ecol.* Open country, often forming large clumps; up to 1300 m alt.; fl. July-Jan., fr. until Feb.

**12. *Erycibe stenophylla* HOOGL. Blumea 7 (1953) 317.—*E. longifolia* BECC. Nelle Foreste di Borneo (1902) 403, 524, f. 65, *nomen* (non *E. glomerata* var. *longifolia* BL.).—Fig. 16.**

Large shrub, branches stellate-hirsute, older ones with low longitudinal cork-ridges. *Leaves* subcoriaceous, linear-lanceolate, slightly falcate, 7-12 by 0.7-1.3 cm, 6-8-nerved; long-acuminate at the apex, acute at the base; glabrous, with



Fig. 16. *Erycibe stenophylla* HOOGL. Flowering branch,  $\times \frac{1}{2}$ .



slightly prominent midrib and nerves and faintly prominent venation above; sparsely stellate-hirsute, soon glabrescent, with slightly prominent nerves and faintly prominent venation beneath. Petiole 4–7 mm. *Inflorescences* axillary or terminal, up to 1 cm, (1)–2–3(–4)-flowered. Pedicel 1–2 mm. *Sepals* 1 & 2 oval, 2.4–3 by 2–2.2 mm, 4 & 5 transverse-oval, 2.3–2.5 by 3.4–3.5 mm; sparsely stellate-hirsute outside (hairs with 3–5 subequal up to 200  $\mu$  long branches). *Corolla* 8–9 mm, tube 2–2½ mm; midpetaline field 3–3.2 by 1.7–1.8 mm, rather densely hairy (hairs 5–7-branched, one stronger up to 350  $\mu$  long branch); lobules 3–3½ by 2–2½ mm, rather thin, with rather distinct venation, entire. *Stamens* inserted 0.7 mm above the corolla-base; filament 0.6 mm long, 0.4 mm broad at the base; anther 1 mm long, 0.7 mm broad, 0.5 mm thick, obtuse at the apex, slightly cordate at the base. *Ovary* 1.2 by 0.7 mm, glabrous; stigma conical, with 5 rather distinct ridges. Fruit unknown.

Distr. *Malaysia*: Borneo (Sarawak), once collected.

Ecol. The plant was collected in the rapids of the Redjang River; it is a typical rheophyte (narrow, slightly falcate leaves). The species is probably most closely related to *E. borneensis* (MERR.) HOOGL.

**13. *Erycibe sericea* HOOGL.** Blumea 7 (1953) 317.

Woody twiner, younger branches rather densely sericeous, older ones with orbicular or oval lenticels. *Leaves* oblong or ovate-oblong, 8–10½ by 3½–5 cm, 6–8-nerved; obtuse, short-acuminate at the apex, obtuse to rounded at the base; glabrous, with sunken midrib, faintly prominent nerves, and nearly indistinct venation above; densely sericeous over the whole surface, with prominent nerves and slightly prominent venation beneath. Petiole ca 1 cm. *Inflorescences* axillary, 5–10 mm, 6–10-flowered. Pedicel 2–3 mm. *Sepals* 1 & 2 orbicular to broad-ovate, 2.4 by 2.6 mm, 4 & 5 transverse-oval, 2.4 by 3.5 mm, rather densely strigose outside (hairs 2-branched, up to 250  $\mu$  total length). *Corolla* 10½ mm, tube 2 mm; midpetaline field 6½ by 3 mm, densely appressed-hairy (hairs 2-branched, up to 500  $\mu$  long); lobules 5 by 4–4½ mm, rather thick, with faintly visible venation, entire. *Stamens* inserted 1.2 mm above the corolla-base; filament 0.7 mm long, 0.3 mm broad at the base; anther 1.8 mm long, 0.7 mm broad, 0.5 mm thick, acute at the apex, slightly cordate at the base. *Ovary* 0.9 by 1.6 mm, rather densely hirsute; stigma conical, with 10 rather distinct ridges. Fruit unknown.

Distr. *Malaysia*: Philippines (Island of Malauai close to N. Basilan, once collected.)

**14. *Erycibe strigosa* PRAIN, J. As. Soc. Beng. 65, 2 (1896) 536; *ibid.* 74, 2 (1906) 288; RIDL. Fl. Mal. Pen. 2 (1923) 445.**

Creeper, 12–18 m long, branches densely thin-strigose, older ones with rather low longitudinal cork-ridges. *Leaves* elliptic-oblong, 7–14 by 3½–6½ cm, 6–8-nerved; obtuse and distinctly

acuminate at the apex, obtuse and slightly decurrent at the base; densely long-strigose, soon glabrescent, with sunken midrib and nerves and faintly prominent venation above; densely long-strigose in young leaves, rather sparsely so in full-grown ones, indumentum long-persistent, with prominent nerves and slightly prominent venation beneath. Petiole 12–20 mm. *Inflorescences* axillary, sometimes 2 or 3 together, the longer ones sometimes with some small leaves in the basal part, 2–12 cm, 20–60-flowered; bracts rather large, up to 5 mm long. *Flowers* known only in bud. Pedicel 1–2 mm. *Sepals* 1 & 2 oval, 2½ by 2 mm, 4 & 5 transverse-oval, 2 by 2½ mm, rather densely thin-strigose outside (hairs 2-branched, up to 900  $\mu$  total length). *Corolla* only slightly developed; midpetaline field with 2-branched, up to 1200  $\mu$  long hairs. *Anthers* acuminate at the apex. *Ovary* glabrous; stigma conical. Fruit unknown.

Distr. *Malaysia*: Malay Peninsula (Perak), once collected.

Ecol. In dense jungle, ca 150–240 m altitude, clinging to trees.

**15. *Erycibe subsericea* HOOGL.** Blumea 7 (1953) 318.

Climber, branches densely short-sericeous, older ones subterete, with rather many orbicular lenticels. *Leaves* coriaceous ovate to elliptic, 9–15 by 5½–9 cm, 5–7-nerved; obtuse, short-acuminate at the apex, obtuse at the base; densely short-sericeous, soon glabrescent, with slightly sunken midrib and nerves and faintly sunken to indistinct venation above; densely short-sericeous (indumentum late caducous), with slightly prominent nerves and faintly to slightly prominent venation beneath. Petiole 15–25 mm. *Inflorescences* axillary, towards the apex of the branches passing into terminal, (2½)–4–25 cm, 10–80-flowered. Pedicel 2–3 mm. *Sepals* 1 & 2 broad-ovate, 4.3 by 3.8 mm, 4 & 5 transverse-oval, 3.4 by 4.2 mm, rather densely strigose outside (hairs 2-branched, up to 250  $\mu$  total length). *Corolla* white, 9 mm, tube 3 mm; midpetaline field 5 by 2.8 mm, densely strigose (hairs 2-branched, up to 900  $\mu$  total length); lobules 3–3.5 by 1.8–2 mm, rather thick, without distinct venation, slightly crenate at the margin. *Stamens* inserted ca 1.4 mm above the corolla-base; filament 0.5 mm long, 0.4 mm broad at base; anther 1.8 mm long, 0.9 mm broad, 0.7 mm thick, acute at the apex, slightly cordate at the base. *Ovary* 1.7 by 1.3 mm, rather densely strigose; stigma conical, with 5 distinct ridges. Fruit unknown.

Distr. *Malaysia*: Borneo (E. Kutei, once collected).

Ecol. In forest along river at low altitude.

**16. *Erycibe kinabaluensis* HOOGL.** Blumea 7 (1953) 315.

A woody twiner, younger branches strigose-hirsute, older ones with rather many oval lenticels. *Leaves* subcoriaceous, oblong, 4½–8½ by 1.8–2½ cm, 7–8-nerved; acuminate at the apex, acute to obtuse at the base; glabrous, with slightly sunken midrib, slightly prominent nerves and venation

above; glabrous (except the sparsely villose, soon glabrescent basal part of midrib), with prominent nerves and venation beneath. Petiole 5–9 mm. *Inflorescences* axillary, sometimes 2 or 3 together, 3–40 mm, (1–)3–20-flowered. Pedicel 2–5 mm. *Sepals* transverse-oval, 1 & 2 1.8 by 2.2 mm, 4 & 5 2 by 2.5–2.7 mm; densely hirsute outside (hairs with 2 branches, rarely a small third branch, up to 900  $\mu$  total length). *Corolla* pale yellow-green, 5½ mm, tube 0.8 mm; midpetaline field 3.2 by 2 mm, densely hirsute (hairs with (2–)3–(4), generally curled, up to 700  $\mu$  long branches); lobules 2 by 2 mm, rather thick, without distinct venation, entire. *Stamens* inserted 0.8 mm above the corolla-base; filament 0.5 mm long, 0.3 mm broad at the base; anther 1.2 mm long, 0.9 mm broad, 0.7 mm thick, obtuse, slightly truncate at the apex, slightly cordate at the base. *Ovary* 0.9 by 1 mm, glabrous; stigma conical, with 5 rather distinct ridges. Fruit unknown.

Distr. *Malaysia*: Br. N. Borneo (Kinabalu), once collected at 1200 m.

**17. *Erycibe maingayi* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 182.—*E. griffithii* (non CLARKE) PRAIN, J. As. Soc. Beng. 74, 2 (1906) 295, p.p.; RIDL. Fl. Mal. Pen. 2 (1923) 447, p.p.**

Scandent shrub or liana, younger branches densely strigose, older ones with longitudinal cork-ridges and rather many oval lenticels. *Leaves* subcoriaceous, ovate-oblong to elliptic-oblong, 4½–13 by 2–6½ cm, 4–7-nerved; rounded to acute, usually more or less acuminate at the apex, obtuse to rounded at the base; glabrous, with slightly sunken midrib and slightly prominent nerves and venation above; glabrous, with distinctly prominent nerves and slightly prominent to indistinct venation beneath. Petiole 8–12 mm. *Inflorescences* axillary, ½–3 cm, (1–)2–14-flowered. Pedicel 1½–4 mm. *Sepals* 1 & 2 broadly ovate, 2–3 by 2½–3 mm, 4 & 5 transverse-oval, 2½ by 3 mm; shortly strigose outside (hairs with 2 branches, up to 600  $\mu$  total length). *Corolla* cream-coloured, 8–9 mm, tube 2½–3½ mm; midpetaline field 2.7–3.8 by 1.7–2 mm, densely appressed-hairy (hairs with (2–)3–(4) up to 800  $\mu$  long branches); lobules 3.5–4 by 2.7–4 mm, rather thick, with not or only faintly visible venation, entire. *Stamens* inserted 0.5–0.8 mm above the corolla-base; filament 0.6–0.9 mm long, 0.3–0.5 mm broad at the base; anther 1.1–1.3 mm long, 0.6 mm broad, 0.3–0.4 mm thick, acuminate (sterile acumen 0.5–0.6 mm) at the apex, cordate at the base. *Ovary* 0.8–1.2 by 0.8–1.1 mm, glabrous; stigma conical, somewhat warty, with 5 distinct ridges. Fruit ellipsoid, 22 by 14 mm, glabrous, smooth. Cotyledons plain.

Distr. *Malaysia*: Sumatra, Malay Peninsula, Br. N. Borneo (Kinabalu).

Ecol. In forests at low alt., in Borneo at 1200 m. Vern. *Akar kajas*, Palembang, *kaju telor ketam*, Johore.

Notes. The specimens from Sumatra are distinctly larger in many parts than most specimens from the Malay Peninsula. I do not think,

however, that the differences justify the distinction of 2 taxa.

The only specimen known from Borneo (CLEMENS 31860) is a rather poor one with poor inflorescences. Otherwise it fits in perfectly with the small Peninsular specimens.

PRAIN (1906) and RIDLEY (1923) reduced the species to *E. griffithii* CLARKE. The most striking differences between the two species are the shape of the stamens and the fruit. Both species have in the herbarium a dark brown, often purple-tinged colour.

**18. *Erycibe coriacea* WALL. [Cat. (1828) no 1337, nomen] ex CHOISY, Ann. Sc. Nat. II, 1 (1834) 224; DC. Prod. 9 (1845) 465; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 182; PRAIN, J. As. Soc. Beng. 65, 2 (1896) 536; KERR, Fl. Siam. En. 3 (1951) 95.—*E. fragrans* WALL. [Cat. (1828) no 1336, nomen] ex G. DON, Gen. Syst. 4 (1838) 392.—*E. coriacea* var. *pauciflora* DC. Prod. 9 (1845) 465.—*E. coriacea* var. *fragrans* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 182.**

Woody climber or small tree, branches sparsely strigose, older ones terete with rather many orbicular lenticels. *Leaves* coriaceous, elliptic to elliptic-oblong, 8–18 by 4–8½ cm, 7–9-nerved; acuminate from an obtuse to rounded apex, rounded to broadly acute at the base; glabrous, with slightly to distinctly sunken midrib, faintly sunken nerves, and faintly sunken to faintly prominent venation above; glabrous, with faintly prominent nerves and faintly prominent to indistinct venation beneath. Petiole 9–18 mm. *Inflorescences* axillary, 1–5 cm, 6–50-flowered. Flowers fragrant. Pedicel 2–5 mm. *Sepals* 1 & 2 oval to orbicular, 2.3–2.5 by 2.2–2.7 mm, 4 & 5 orbicular to transverse-oval, 2.3–2.5 by 2.7–3.3 mm, rather sparsely to rather densely strigose outside (hairs 2-branched, up to 400  $\mu$  total length). *Corolla* white, 8½–9 mm, tube 2–3 mm; midpetaline field 4 by 2.2–2.8 mm, rather densely appressed-hairy (hairs 2-branched, up to 800  $\mu$  total length); lobules 3½–4½ by 3½–4½ mm, with not too distinct venation, entire, coherent above the midpetaline field for up to 0.4 mm. *Stamens* inserted 0.8–1.5 mm above corolla-base; filament 0.7–1.2 mm long, 0.4–0.6 mm broad at the base; anther 2 mm long, 0.8–0.9 mm broad, 0.5–0.6 mm thick, acute at the apex, cordate at the base. *Ovary* 1.2–1.7 by 1.5–1.7 mm, rather densely appressed-hairy; stigma conical, with 10 rather low ridges. Fruit ellipsoid, 30 by 18 mm, glabrous, smooth, orange. Cotyledons plain.

Distr. Chittagong, S. Burma, S. Siam, in *Malaysia*: only found in Peninsular Siam.

Ecol. In evergreen forest, up to 200 m.

**19. *Erycibe festiva* PRAIN, J. As. Soc. Beng. 58, 2 (1894) 87; *ibid.* 65, 2 (1896) 536; *ibid.* 74, 2 (1906) 292; RIDL. Fl. Mal. Pen. 2 (1923) 447.**

Creepers, up to 20 m long, 7½ cm diam., younger branches strigose, older ones terete with rather many orbicular lenticels. *Leaves* subcoriaceous, elliptic-oblong to oblong or ovate-oblong, 7–14 by

3-7 cm, 7-9-nerved; acute to obtuse, slightly acuminate at the apex; obtuse to acute at the base; glabrous, with slightly sunken midrib, faintly prominent nerves, and indistinct to faintly prominent venation above; glabrous, with slightly prominent nerves and faintly prominent venation beneath. Petiole 8-12 mm. *Inflorescences* axillary, up to 1½ cm, (3)-6-12(-15)-flowered. Pedicel 1½-4 mm. *Sepals* 1 & 2 broad-ovate to orbicular or transverse-oval, 2-2.5 by 2.2-2.8 mm, 4 & 5 transverse-oval, 2-2.2 by 3-3.5 mm, rather densely to densely strigose outside (hairs 2-branched, up to 350 µ total length). *Corolla* pale greenish white, 7-9½ mm, tube 1½-3 mm; midpetaline field 3-4 by 2.2-3 mm, densely appressed-hairy (hairs 2-branched, up to 600 µ total length); lobules 3½-4½ by 3-3½ mm, rather thin, with faintly distinct to distinct venation, slightly crenate at margin, coherent above the midpetaline field for 1 mm. *Stamens* inserted 0.8-1.2 mm above the corolla-base; filament 0.7-1 mm long, 0.4-0.6 mm broad at the base; anther 1-1.9 mm long, 0.6-0.8 mm broad, 0.4-0.5 mm thick, acute at the apex, cordate at the base. *Ovary* 1-1.5 by 1.3-1.7 mm, rather densely appressed-hairy for whole surface or the upper part only; stigma conical, with 10 rather distinct ridges. Fruit unknown.

Distr. *Malaysia*: Malay Peninsula, Banka, W. Java, at low altitudes.

Vern. *Akar pusak blanak*, *akar surawan jantan*, Mal. Pen., *aroy mugmal*, S.

Note. The inflorescence was originally described as many-flowered; PRAIN corrected this later (1896) to 7-12-flowered.

**20. *Erycibe terminaliflora*** ELM. Leaf. Philip. Bot. 5 (1913) 1768; MERR. En. Philip. 3 (1923) 359.—*E. hallieriana* ELM. *ibid.* 7 (1915) 2603.—*E. pararan* ELM. *ibid.* 7 (1915) 2603.—*E. copelandii* ELM. *ibid.* 8 (1919) 3077.—*E. rheedii* (non BL.) MERR. En. Philip. 3 (1923) 358, *p.p.*

Large climber, branches rather densely to densely strigose-hirsute, older ones subterete, with rather many orbicular to oval lenticels. *Leaves* coriaceous, ovate to ovate-oblong or elliptic-oblong, 4½-10(-14) by 2-4½(-6) cm, 8-12-nerved; obtuse, short-acuminate at the apex, obtuse at the base; glabrous, shining, with slightly sunken midrib, slightly prominent nerves and major venation, and faintly prominent or indistinct minor venation above; rather sparsely hirsute, glabrescent, with slightly prominent nerves and venation beneath. Petiole 9-14 mm. *Inflorescences* axillary, towards the apex of the branches passing into terminal, then usually with some small leaves in the basal part, (2½)-4-25 cm, 10-125-flowered, terminal ones up to 250-flowered. Pedicel 3-5 mm. *Sepals* 1 & 2 broad-ovate or orbicular to transverse-oval, 2.4-3.6 by 2.6-4.2 mm, 4 & 5 transverse-oval, 2.1-3 by 2.8-4 mm, sparsely to densely strigose outside (hairs 2-branched, up to 500 µ total length). *Corolla* white or yellowish white, 6½-9½ mm, tube 2-2½ mm; midpetaline field 3-4.8 by 1.8-3.3 mm, rather densely to densely strigose (hairs 2-

branched, up to 900 µ long); lobules 3-4 by 2½-4 mm, rather thin to rather thick, with no or only faintly distinct venation, slightly crenate, or undulate, or entire at the margin, sometimes coherent above the midpetaline field for up to 0.8 mm. *Stamens* inserted 0.7-1.5 mm above the corolla-base; filament 0.5-1.3 mm long, 0.2-0.6 mm broad at the base; anther 1.3-2 mm long, 0.5-0.7 mm broad, 0.5-0.7 mm thick, acute to acuminate at the apex (sterile acumen up to 0.2 mm), cordate at the base. *Ovary* 1-1.8 by 1-1.7 mm, glabrous, or rather sparsely hairy in the upper, glabrous in the lower part, or rather sparsely hairy over the whole surface; stigma conical, with 5 or 10 faint to distinct ridges. *Fruit* ellipsoid, 8 by 5 mm, light green, glabrous, smooth, or (at least in young stages) with dense appressed indumentum. Cotyledons plain.

Distr. *Malaysia*: Philippines.

Ecol. In forests, from low altitude to 1200 m.

Vern. *Pararan*, *salibútbut*, Bag.

Note. The type represents a relatively hirsute form, all other specimens are distinctly less hairy. The species is rather variable, but there is no good character on which it can be divided into more taxa.

**21. *Erycibe hollrungii*** HOOGL. Blumea 7 (1953) 314.—*E. paniculata* (non ROXB.) K. SCHUM. & HOLLR. Fl. Kais. Wilh. Land (1889) 114.—*E. hellwigii* (non PRAIN) K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 518, *p.p.*

Scandent shrub, younger branches densely strigose, older ones with distinct longitudinal cork-ridges. *Leaves* ovate-oblong, (6-)10-14 by (2½)-4½-6½ cm, 5-7-nerved; obtuse, often slightly acuminate at the apex, obtuse to rounded at the base; sparsely strigose, soon glabrescent, with slightly sunken midrib, faintly prominent nerves, and indistinct or very faintly prominent venation above; rather sparsely short-strigose, soon glabrescent, with prominent nerves and indistinct venation, or at most major venation faintly prominent or minor venation faintly sunken. Petiole 5-12 mm. *Inflorescences* axillary, towards the end of the branches passing into terminal, 3-10 cm, 25-75-flowered, with minute and few larger (up to 12 by 3½ mm) bracts. Pedicel 1½-4 mm. *Sepals* transverse-oval, 1 & 2 2.2 by 2.5 mm, 4 & 5 2 by 3 mm, rather densely short-strigose outside (hairs 2-branched, up to 450 µ total length). *Corolla* 7 mm, tube 2 mm; midpetaline field 4 by 2 mm, rather densely hairy (hairs mainly 2-branched, up to 1250 µ total length); lobules 3 by 2½-3 mm, without distinct venation, entire. *Stamens* inserted 0.6 mm above the corolla-base; filament 0.8 mm long, 0.4 mm broad at the base; anther 1.5 mm long, 0.7 mm broad, 0.5 mm thick, acuminate (sterile acumen 0.2 mm) at the apex, cordate at the base. *Ovary* 0.9 by 0.9 mm, glabrous in the lower 0.3 mm, densely hairy in the upper part; stigma conical, with 5 rather distinct ridges. Fruit unknown.

Distr. *Malaysia*: N. E. New Guinea, once collected.

**22. *Erycibe ramosii* HOOGL.** *Blumea* 7 (1953) 316.

Scandent, younger branches densely strigose-hirsute, older ones with distinct longitudinal cork-ridges. *Leaves* elliptic-oblong to oblong, 5–10 by  $1\frac{3}{4}$ –4 cm, 7–10-nerved; shortly to long acuminate from an obtuse to acute apex, obtuse to acute at the base; densely strigose-hirsute, soon glabrescent, with slightly sunken midrib and slightly prominent nerves and venation above; densely strigose-hirsute, soon glabrescent, with slightly prominent nerves and major venation, and faintly prominent to indistinct minor venation beneath. Petiole 10–16 mm. *Inflorescences* terminal or axillary, 2–6 cm, 10–60-flowered. Pedicel 2–3 mm. *Sepals* 1 & 2 orbicular, 2.3 by 2.3 mm, 4 & 5 transverse-oval, 2.2 by 3 mm, rather densely appressed-hairy outside (hairs 2-branched, up to 400  $\mu$  total length). *Corolla*  $7\frac{1}{2}$  mm, tube 2 mm; midpetaline field 3.5 by 2.1 mm, rather densely appressed-hairy (hairs 2-branched, up to 700  $\mu$  total length); lobules  $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm, without distinct venation, slightly crenulate at margin. *Stamens* inserted 1.2 mm above the corolla-base; filament 1 mm long, 0.6 mm broad at the base; anther 1.2 mm long, 0.7 mm broad, 0.4 mm thick, acute at the apex, cordate at the base. *Ovary* 1.4 by 1.5 mm, appressed-hairy over the whole surface; stigma conical, with 5 faint ridges. *Fruit* ellipsoid, 20 by 12 mm, glabrous except few hairs near the apex, smooth. Cotyledons plain.

Distr. *Malaysia*: Philippines (Luzon, Leyte).

**23. *Erycibe glomerata* BL.** *Bijdr.* 16 (1826) 1047; G. DON, *Gen. Syst.* 4 (1838) 392; MIQ. *Fl. Ind. Bat.* 2 (1859) 1033; KOORD. *Exk. Fl. Java* 3 (1912) 115; OOSTSTR. in BACK. *Bekn. Fl. Java* (em. ed.) 8 (1949) fam. 191, 8.—*E. glomerata* var. *longifolia* BL. *Bijdr.* 16 (1826) 1047; MERR. *En. Born.* (1921) 507.—*E. angustifolia* HALLIER f. *Bot. Jahrb.* 16 (1893) 524.

KEY TO THE SUBSPECIES

1. Sepals sparsely appressed-hairy outside in central part only; longest hairs ca 700  $\mu$  long.  
ssp. *glomerata*
1. Sepals densely appressed-hairy outside, the 2 outer ones for the whole surface; longest hairs ca 1250–1500  $\mu$  long ssp. *angustifolia*

ssp. *glomerata*.—*E. glomerata* BL. 1826.—*E. glomerata* var. *longifolia* BL. 1826.

Liana, branches sparsely appressed-hairy, older ones subterete or with low longitudinal ridges. *Leaves* subcoriaceous, elliptic-oblong to narrowly oblong, 8–18 by  $3\frac{1}{2}$ – $7\frac{1}{2}$  cm, 6–9-nerved; acuminate from an obtuse to acute apex, obtuse to acute at the base; rather sparsely appressed-hairy, soon glabrescent, with faintly prominent to slightly sunken midrib, faintly prominent nerves, and faintly prominent to indistinct venation above; rather sparsely appressed-hairy, soon glabrescent, with faintly prominent nerves and faintly prominent to indistinct venation, silvery shining beneath. Petiole  $\frac{1}{2}$ –1 cm. *Inflorescences* axillary, up to

$1\frac{1}{2}$  cm, (1–)2–15-flowered, forming a dense cluster. Pedicel 1–3 mm, with 2–5 oval or ovate, up to 3 mm long bracts and bracteoles. *Sepals* subequal, oval to transverse-oval, 3.2–3.8 by 2.7–4.2 mm, sparsely appressed-hairy in the central part outside (hairs 2-branched, up to 700  $\mu$  total length). *Corolla* white, 13– $13\frac{1}{2}$  mm, tube 3 mm; midpetaline field 4.4–5 by 1.8–2.3 mm, rather densely appressed-hairy (hairs 2-branched, up to 1250  $\mu$  total length); lobules  $7\frac{1}{2}$  by 3– $3\frac{1}{2}$  mm, rather thin, with rather distinct venation, entire or slightly crenate at the margin. *Stamens* inserted 0.7 mm above the corolla-base; filament 1–1.6 mm long, 0.5–0.6 mm broad at the base; anther 1.1–1.2 mm long, 0.7–0.8 mm broad, 0.5 mm thick, acute to obtuse at the apex, cordate at the base. *Ovary* 1–1.1 by 1.3–1.7 mm, glabrous; stigma conical, with 5 or 10 ridges. Fruit unknown.

Distr. *Malaysia*: Sumatra, W. Java.

Vern. *Kisimut*, S.

ssp. *angustifolia* (HALLIER f.) HOOGL. *stat. nov.*—*E. angustifolia* HALLIER f. 1893.

Differs from ssp. *glomerata* by the following characters:

*Leaves* generally slightly narrower. *Inflorescences* rarely up to 3 cm long. *Sepals* 1 & 2 orbicular to transverse-oval, 2.5–3 by 2.5–3.8 mm, 4 & 5 transverse-oval, 2.5–2.8 by 3–3.7 mm, densely appressed-hairy outside (hairs 2-branched, up to 1500  $\mu$  total length). *Corolla* 8– $10\frac{1}{2}$  mm, tube 2–3 mm; midpetaline field 2.8–4 by 1.7–2.3 mm (hairs up to 1500  $\mu$  total length); lobules 4– $5\frac{1}{2}$  by 3– $3\frac{1}{2}$  mm. *Stamens* inserted 0.6–0.8 mm above the corolla-base; anther 1.5–1.7 mm long, 0.5–0.9 mm broad, 0.5 mm thick.

Distr. *Malaysia*: Borneo.

Notes. The differences between the subspecies are slight, but sharp as far as I can judge from the available material. Of ssp. *glomerata* only rather old Javanese material is available; this subspecies has not been recollected in recent times. The same subspecies is known from Sumatra by a single, unlocalized collection (KORTHALS).

A closely related species is *E. albida* PRAIN from the Malay Peninsula.

**24. *Erycibe elliptilimba* MERR. & CHUN.** *Sunyatsenia* 2 (1934) 45; HOW, *ibid.* 6 (1946) 227.—*E. paniculata* (non ROXB.) GAGNEP. & COURCH. *Fl. Gén. I. C.* 4 (1915) 305.—*E. fecunda* KERR, *Kew Bull.* (1941) 10; *Fl. Siam. En.* 3 (1951) 96.—*E. noi* KERR, *Kew Bull.* (1941) 11; *Fl. Siam. En.* 3 (1951) 97.—*E. rabillii* KERR, *Kew Bull.* (1941) 12; *Fl. Siam. En.* 3 (1951) 97.—*E. poilanei* GAGNEP. *Not. Syst.* 14 (1950) 28.

Liana, up to 20 m by 8 cm, younger branches rather densely strigose-hirsute, older ones with distinct longitudinal cork-ridges. *Leaves* subcoriaceous, oval to oblong, (5–)7–12(–16) by (2–)3– $6\frac{1}{2}$ (– $9\frac{1}{2}$ ) cm, 5–7(–8)-nerved; rounded to broad-acute, usually short-acuminate at the apex, rounded to broad-acute at the base; glabrous, with distinctly sunken midrib and distinctly to faintly sunken nerves and venation above; glabrous, with

faintly prominent to faintly sunken nerves and faintly to distinctly sunken venation beneath. *Inflorescences* axillary, sometimes 2 or 3 together, (1 $\frac{1}{2}$ –)3–8(–11) cm, (5–)15–40(–60)-flowered. Pedicel 1 $\frac{1}{2}$ –4 mm. *Sepals* orbicular to transverse-oval, 1 & 2 2–3.5 by 2.5–3.7 mm, 4 & 5 2.5–3 by 2.5–4 mm, rather sparsely to rather densely appressed-hairy outside (hairs 2-branched, up to 800  $\mu$  total length). *Corolla* 6 $\frac{1}{2}$ –10 $\frac{1}{2}$  mm, tube 2–2 $\frac{1}{2}$  mm; midpetaline field 3.2–5.2 by 2–2.6 mm, rather densely appressed-hairy (hairs 2-branched, up to 1400  $\mu$  total length); lobules 3.5–5 by 3–4.2 mm, with no or only slightly distinct venation, grossly dentate at the margin. *Stamens* inserted 0.5–1 mm above the corolla-base; filament 0.7–1.7 mm long, 0.3–0.6 mm broad at the base; anther 1.3–2.0 mm long, 0.5–0.8 mm broad, 0.4–0.5 mm thick, acute-acuminate at the apex, cordate at the base. *Ovary* 1.3–1.6 by 1.2–1.6 mm, glabrous; stigma conical, with 5 rather distinct ridges. *Fruit* ellipsoid, 2 by 1 $\frac{1}{2}$  cm, glabrous, smooth. Cotyledons strongly folded.

Distr. S. China (Hainan), Indo-China, Siam, in *Malaysia*: Peninsular Siam.

Ecol. In forests, from low altitude up to 1200 m (Indo-China).

Vern. *Changsang sapman*, *hora* (Siamese).

**25. *Erycibe floribunda* PILGER**, Bot. Jahrb. 59 (1924) 84; OOSTSTR. J. Arn. Arb. 29 (1948) 416.

Scandent shrub or liana, younger branches rather sparsely strigose, older ones with longitudinal cork-ridges. *Leaves* ovate to ovate-oblong, (8–)12–19 by (3 $\frac{1}{2}$ –)5–10 cm, 5–8-nerved; obtuse to acute, often more or less acuminate at the apex, acute to, usually, obtuse at the base; glabrous, with slightly sunken midrib and prominent nerves and venation above; glabrous, with prominent nerves and slightly prominent venation beneath. Petiole 5–15 mm. *Inflorescences* axillary, sometimes 2 or 3 together, or terminal, (3–)8–18 cm, 30–100- or more-flowered. Pedicel 1–2 $\frac{1}{2}$  mm. *Sepals* 1 & 2 oval, 2–2.2 by 1.7–2 mm, 4 & 5 transverse-oval, 1.8–2 by 2.5 mm, rather densely strigose outside (hairs 2-branched, up to 600  $\mu$  total length). *Corolla* white, yellowish white, or yellow, 5 $\frac{1}{2}$ –6 mm, tube 1 $\frac{1}{2}$ –2 mm; midpetaline field 2.4–2.8 by 1.8 mm, rather sparsely appressed-hairy (hairs mainly 2-branched, up to 800  $\mu$  total length); lobules 1.8–2.3 by 2–2.5 mm, without distinct venation, entire. *Stamens* inserted  $\frac{1}{2}$  mm above the corolla-base; filament 0.8–1 mm long, 0.4–0.5 mm broad at the base; anther 1.1–1.2 mm long, 0.7–0.8 mm broad, 0.4–0.5 mm thick, obtuse to acuminate at the apex (sterile acumen 0.1–0.4 mm), rounded to slightly cordate at the base. *Ovary* 0.8–1.3 by 0.7–0.9 mm, glabrous; stigma conical, with 10 rather distinct ridges. *Fruit* ellipsoid, 13 by 8 mm, glabrous, red or orange-brown. Cotyledons plain.

Distr. *Malaysia*: W. New Guinea (not yet found in the Vogelkop).

Ecol. In fringing forest, up to 300 m altitude.

**26. *Erycibe forbesii* PRAIN**, J. As. Soc. Beng. 73, 2 (1904) 15.

Liana, younger branches rather densely appressed-hairy, older ones with distinct, generally broad, longitudinal cork-ridges. *Leaves* ovate or obovate to oblong, (5–)7–12(–15) by (2 $\frac{1}{4}$ –)3–6 (–7 $\frac{1}{2}$ ) cm, (4–)5–8-nerved; rather sparsely appressed-hairy, soon glabrescent, with slightly sunken midrib, faintly prominent to faintly sunken nerves, and faintly prominent to indistinct venation above; rather sparsely appressed-hairy, soon glabrescent, with slightly to faintly prominent nerves and venation beneath. Petiole 8–17 mm. *Inflorescences* terminal, downward passing into axillary, sometimes 2 together, (1 $\frac{1}{2}$ –)3–8 (–12) cm, (5–)10–30(–100)-flowered. Pedicel 1 $\frac{1}{2}$ –4 mm. *Sepals* 1 & 2 oval to orbicular, 2–4 by 2–3.2 mm, 4 & 5 transverse-oval, 1.8–3.2 by 2.2–4 mm, rather densely appressed-hairy outside (hairs 2-branched, up to 900  $\mu$  total length). *Corolla* white, 6–9 $\frac{1}{2}$  mm, tube 2–3 mm; midpetaline field 1.8–4 by 1.3–2.8 mm, rather densely appressed-hairy (hairs 2-branched, up to 1400  $\mu$  total length); lobules 2 $\frac{1}{2}$ –4 $\frac{1}{2}$  by 1 $\frac{1}{2}$ –3 mm, rather thick, with faintly visible venation, entire to irregularly crenulate at margin, coherent above the midpetaline field for up to 1 mm. *Stamens* inserted  $\frac{1}{2}$ –1 mm above the corolla-base; filament 1.5–1.8 mm long, 0.3–0.7 mm broad at the base; anther 1–2 mm long, 0.4–0.8 mm broad, 0.4–0.6 mm thick, acuminate (sterile acumen 0.3–0.7 mm) at apex, cordate at base. *Ovary* 0.8–1.7 by 0.8–1.5 mm, glabrous; stigma conical, with 5 distinct ridges. *Fruit* ellipsoid, 18 by 15 mm, glabrous, smooth in the lower, scurfy in the upper part, or scurfy over the whole surface. Cotyledons strongly folded.

Distr. *Malaysia*: Sumatra (Lampongs), Java (W. & E.), Kangean Archipelago, Borneo (Balikpapan), and Philippines.

Ecol. In primary forest, at low altitude (up to 600 m).

Vern. *Kisemut*, S.

Note. In the Philippine specimens the fruits are scurfy over the whole surface, in the Javanese ones the lower part is smooth. (The Bornean collection is in flower.) What the taxonomic value of this character is can not yet be decided because of the small number of available specimens, particularly in the intermediate area.

**27. *Erycibe grandifolia* MERR. ex HOOGL.** Blumea 7 (1953) 313.—*E. angulata* (non PRAIN) MERR. J. Mal. Br. R. As. Soc. 1 (1923) 29; Univ. Calif. Publ. Bot. 15 (1929) 259.—*E. rheedii* (non BL.) MERR. Philip. J. Sc. 29 (1926) 413.

Liana, up to 6 cm thick, younger branches stellate-hirsute with very short dark rufous hairs, older ones with very few orbicular lenticles. *Leaves* coriaceous, shining deep green above, much paler beneath, elliptic-oblong to oblong, ovate-oblong, or obovate-oblong, 7–23 by 3 $\frac{1}{2}$ –12 $\frac{1}{2}$  cm, 7–10-nerved; rather shortly acuminate from an obtuse apex, (acute to) obtuse to rounded, sometimes slightly cordate at the base; glabrous, with slightly sunken to slightly raised midrib and nerves

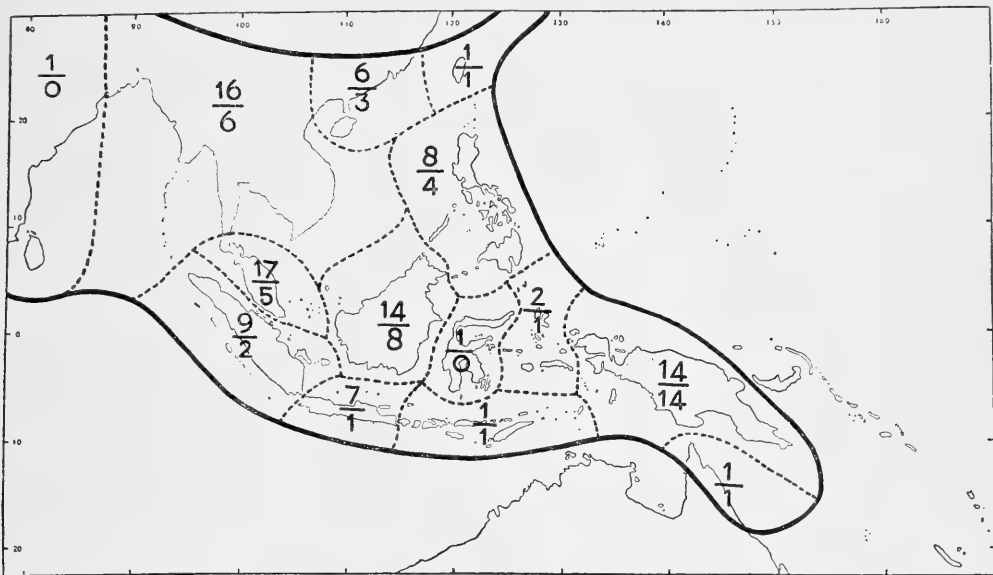


Fig. 17. Distribution of the genus *Erycibe* in which are indicated for each sub-area the total number of species (above the line) and the number of endemic species (under the line). The genus comprises 66 spp. In India the area extends W to the Bombay Province and N to the Upper Gangetic Plain and the Sikkim Himalaya. The Formosan area extends over the Riu-Kiu Islands to Yakushima (S. Japan). The numbers in Borneo should be read  $16/9$  and in Sumatra  $10/2$ .

and faintly sunken to faintly raised venation above; densely stellate-hirsute, very soon glabrescent, with faintly raised to slightly sunken nerves and distinctly sunken venation beneath; margin often slightly recurved. Petiole 10–22 mm. Inflorescences terminal, often with some leaves in basal part, or axillary, 2–20 cm, 20–200-flowered. Pedicel 1–2½ mm. Sepals 1 & 2 broadly ovate, 1.6–2.5 by 1.5–2 mm, 4 & 5 transverse-oval, 1.3–1.9 by 2.2–2.6 mm; rather densely stellate-hirsute outside (hairs with 5–11 subequal, up to 250  $\mu$  long branches). Corolla pale yellow or yellow, 6–7 mm, tube 1½–2 mm; midpetaline field 3.2–3.7 by 1.7–2 mm, densely stellate-hirsute (hairs with 6–12 subequal, up to 250  $\mu$  long branches); lobules 2 by 2½ mm, without distinct venation, entire. Stamens inserted 0.5–0.9 mm above the corolla-base; filament 0.5–0.7 mm long, 0.3–0.5 mm broad at the base; anther 1.2 mm long, 0.4–0.6 mm broad, 0.3–0.4 mm thick, acute at the apex, slightly cordate at the base. Ovary 1 by 0.8–1.2 mm, glabrous in the lower 0.2–0.4 mm, stellate-hirsute in the upper part; stigma conical, with 10 low ridges. Fruit ellipsoid, 20 by 14 mm, dark brown, yellow, or aurantiaceous, with a dense indumentum of very short stellate hairs. Cotyledons plain.

Distr. *Malaysia*: Borneo (Br. N. Borneo and E. Indonesian Borneo).

Ecol. In primary and secondary forests at low altitude.

Vern. *Tikboi*, Sandakan.

## 28. *Erycibe carriei* HOOGL. *Blumea* 7 (1953) 312.

Liana, young branches stellate-hirsute, older ones with longitudinal cork-ridges. Leaves subcoriaceous, ovate to ovate-oblong, (2.7–)4.5–8 by (0.9–)1.6–3.5 cm, 6–8-nerved; obtuse to acute or slightly acuminate at the apex, obtuse to rounded at the base; stellate-hirsute, glabrescent, with slightly sunken midrib and slightly prominent nerves and venation above; stellate-hirsute, indumentum long persistent, with slightly prominent nerves and venation beneath. Petiole 6–10 mm. Inflorescences axillary, sometimes 2 or 3 together, (1–)3–10 cm, (3–)7–50-flowered. Flowers fragrant. Pedicel 2–4 mm. Sepals 1 & 2 oval, 2–2.2 by 1.6–1.9 mm, 4 & 5 transverse-oval, 2–2.2 by 2.5–2.8 mm, rather densely stellate-hirsute (hairs with (2–)4–9(–11) subequal, up to 350  $\mu$  long branches). Corolla white, 6½–7 mm, tube 2 mm; midpetaline field 3 by 1.8 mm, rather densely appressed-hairy (hairs with (2–)3–6 subequal, up to 750  $\mu$  long branches); lobules 2.5–3 by 2.8–3 mm, without distinct venation, slightly undulate at the margin. Stamens inserted ½ mm above the corolla-base; filament 0.5–0.6 mm long, 0.3 mm broad at the base; anther 1.2–1.4 mm long, 0.8 mm broad, 0.5–0.6 mm thick, acuminate (sterile acumen 0.3–0.5 mm long) at the apex, subcordate at the base. Ovary 0.9–1.0 by 0.8 mm, glabrous for the lower 0.3–0.6 mm, sparsely stellate-hirsute for the upper part; stigma conical, with 5 distinct ridges. Fruit unknown.

Distr. *Malaysia*: E. New Guinea.  
Ecol. In forests at ca 1250 m.

**29. *Erycibe bullata* RIDL. ex HOOGL.** *Blumea* 7 (1953) 311.

Young branches stellate-hirsute, older ones probably with longitudinal cork-ridges. *Leaves* subcoriaceous, oblong, ovate-oblong, or obovate-oblong, 18–25 by 7½–11 cm, 9–12-nerved; shortly acuminate at the apex, acute to obtuse at the base; stellate-hirsute, soon glabrescent, with midrib, nerves, and main venation sunken between the bullate intervenium above; stellate-hirsute, hairs rather long persistent, with prominent nerves and main venation, and invisible minor venation beneath; margin recurved. Petiole 6–16 mm. *Inflorescences* axillary, up to 2 cm, 1–±15-flowered, forming a dense cluster; bracts lanceolate, 3 mm long. Pedicel 3–4 mm; bracteoles lanceolate, 2–2½ mm long. *Sepals* 1 & 2 broadly ovate, 2 by 2.2 mm, 4 & 5 transverse-oval, 1.9 by 2.2 mm, stellate-hirsute outside (hairs (2–)3–5-branched, branches subequal or one branch somewhat longer, up to 500 µ long). *Corolla* 8 mm, tube 2 mm; midpetaline field 3.5 by 1.8 mm, rather sparsely stellate-hirsute (hairs with 3–6 subequal, up to 400 µ long branches); lobules 2.8 by 2 mm, rather thin, with distinct venation, entire. *Stamens* inserted 1 mm above the corolla-base; filament 1 mm long, 0.4 mm broad at the base; anther 1 mm long, 0.5 mm broad, 0.3 mm thick, acute at the apex, cordate at the base. *Ovary* 1.5 by 0.7 mm, glabrous; stigma conical, with 5 rather sharp ridges. *Fruit* ellipsoid, 20 by 12 mm, glabrous, white. Cotyledons plain.

Distr. *Malaysia*: Borneo (Sarawak).

**30. *Erycibe crassipes* RIDL. ex HOOGL.** *Blumea* 7 (1953) 312.

Climbing shrub, 3 m high, younger branches stellate-hirsute, soon glabrescent, older ones with longitudinal cork-ridges. *Leaves* subcoriaceous, oblong to lanceolate-oblong, 16–37 by 6½–9 cm, 8–12(–15)-nerved; (obtuse to) acute, usually acuminate at the apex, obtuse to acute, slightly decurrent at the base; densely stellate-hirsute, soon glabrescent, with slightly sunken midrib, faintly prominent nerves, and indistinct venation above; densely stellate-hirsute, very soon glabrescent, with prominent nerves and faintly prominent to indistinct venation beneath. Petiole 8–15 mm. *Inflorescences* axillary (often on older defoliate branches), (1–)3–±10-flowered, forming a dense cluster. Pedicel 1–3 mm. *Sepals* 1 & 2 oval to orbicular, 2.6–3 by 2.3–2.8 mm, 4 & 5 orbicular to transverse-oval, 2.7–2.8 by 2.8–3.5 mm, sparsely stellate-hirsute outside (hairs with 4–8 subequal, up to 150 µ long branches), or glabrous (*f. glabra* HOOGL.) outside. *Corolla* white, 10½–11 mm, tube 2–2¾ mm; midpetaline field 3–4 by 1½–2 mm, rather densely stellate-hirsute (hairs with 4–9 subequal, up to 200 µ long branches); lobules 4.3–6 by 2–3 mm, rather thin, with distinct venation, entire. *Stamens* inserted at 0.8–1.4 mm above the corolla-base; filament 1–1.3 mm long, 0.4–0.6

mm broad at the base; anther 1–1.2 mm long, 0.5–0.7 mm broad, 0.4–0.5 mm thick, broadly acute at the apex, slightly cordate at the base. *Ovary* 1–1.5 by 0.9–1.2 mm, glabrous; stigma conical, with 10 rather distinct ridges. *Fruit* unknown.

Distr. *Malaysia*: Borneo (Kuching, Natuna Islands).

Ecol. In primary forests.

Note. In the collection from the Natuna Islands the sepals are completely glabrous outside, the pedicel is stellate-hirsute under the calyx like in the other collections. I do not think this difference to be of great value in this case.

**31. *Erycibe nitidula* PILGER.** *Bot. Jahrb.* 59 (1924) 85.

Scandent, younger branches stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* elliptic-oblong, 8–12 by 3½–5½ cm, 5–7-nerved, obtuse to rounded, short-acuminate at the apex, obtuse at the base; glabrous, with sunken midrib and slightly prominent nerves and venation above; rather sparsely, along midrib densely stellate-hirsute, glabrescent, with prominent nerves and slightly prominent venation beneath. Petiole 6–10 mm. *Inflorescences* terminal, downward passing into axillary, 3–20, axillary ones –9 cm, 10–40-flowered. Pedicel 1½–4 mm. *Sepals* 1 & 2 orbicular, 2.4 by 2.4 mm, 4 & 5 transverse-oval, 2.4 by 3.2 mm, densely stellate-hirsute outside (hairs with 4–7 subequal, up to 150 µ long branches). *Corolla* 7½ mm, tube 2 mm; midpetaline field 4 by 2.2 mm, densely stellate-hirsute (hairs with unequal, up to 500 µ long branches); lobules 3 by 3.2 mm, with hardly visible venation, entire. *Stamens* inserted 0.7 mm above the corolla-base; filament 1 mm long, 0.6 mm broad at the base; anther 1.5 mm long, 0.8 mm broad, 0.7 mm thick, acuminate (sterile apex 0.6 mm) at the apex, cordate at the base. *Ovary* 1 by 1.2 mm, rather densely stellate-hirsute; stigma conical, with 10 rather distinct ridges. *Fruit* unknown.

Distr. *Malaysia*: E. New Guinea (Penebo near Bulu), once collected.

Ecol. In forests at 450 m.

**32. *Erycibe papuana* WERNH.** *Trans. Linn. Soc. Bot.* 9 (1916) 118.

Scandent, younger branches stellate-hirsute, older ones with distinct longitudinal cork-ridges. *Leaves* narrowly ovate, up to 14 by 6½ cm, 5–7-nerved; obtuse, very slightly acuminate at the apex, obtuse, slightly decurrent at the base; glabrous, with slightly sunken midrib and slightly prominent nerves and venation above; glabrous, with slightly prominent nerves and venation beneath. Petiole up to 10 mm. *Inflorescences* axillary, up to 10 cm, up to 50-flowered. Pedicel 1–3 mm. *Sepals* 1 & 2 oval, 2.7 by 2.3 mm, 4 & 5 transverse-oval, 2 by 2.5 mm, rather sparsely stellate-hirsute outside (hairs with (2–)3–4 subequal, up to 250 µ long branches). *Corolla* pale yellow, 5½ mm, tube 1½ mm; midpetaline field 2 by 1.6 mm, rather densely hairy (hairs 2–5-branched, branches sub-



equal or one slightly longer and stronger than the others; total length up to 1000  $\mu$ ; lobules 2 by 2.4 mm, without distinct venation, entire. *Stamens* inserted 0.5 mm above the corolla-base; filament 1.5 mm long, 0.3 mm broad at the base; anther 1.4 mm long, 0.8 mm broad, 0.7 mm thick, acuminate (sterile acumen 0.4 mm) at the apex, cordate at the base. *Ovary* 1.3 by 1 mm, glabrous except few hairs at apex; stigma conical, with 5 distinct ridges. *Fruit* unknown.

*Distr. Malaysia:* SW. New Guinea (Utakwa River), once collected at ca 45 m.

**33. *Erycibe stapfiana*** PRAIN, J. As. Soc. Beng. 58, 2 (1894) 87; *ibid.* 74, 2 (1906) 293; RIDL. Fl. Mal. Pen. 2 (1923) 448.

Creeper or climber, up to 30 m long, younger branches densely stellate-hirsute, older ones with small orbicular lenticels. *Leaves* coriaceous, elliptic-oblong to oblong, (5–)6 $\frac{1}{2}$ –15(–17) by (1.8–)2.5–6(–7 $\frac{1}{2}$ ) cm, 4–6(–7)-nerved; acuminate from an obtuse apex, obtuse to rounded, sometimes minutely cordate at the base; densely stellate-hirsute, soon glabrescent, with slightly sunken to prominent midrib, slightly sunken nerves, and faintly prominent venation above; densely stellate-hirsute, soon glabrescent, with prominent nerves and venation beneath. Petiole 3–7 mm. *Inflorescences* axillary, often 2–4 together, 1–4 (in fruit up to 7) cm, 4–25-flowered. Pedicel 1 $\frac{1}{2}$ –3 mm. *Sepals* 1 & 2 oval to orbicular, 2–2.5 by 1.6–2.3 mm, 4 & 5 orbicular to transverse-oval, 1.8–2.2 by 1.8–2.5 mm; rather sparsely stellate-hirsute outside (hairs with 5–8 subequal, up to 300  $\mu$  long branches). *Corolla* pale waxy white, 6 $\frac{1}{2}$ –8 mm, tube 1 $\frac{1}{2}$ –2 mm; midpetaline field 2.6–4 by 1.6–1.8 mm, rather densely stellate-hirsute (hairs with 5–8 subequal, up to 350  $\mu$  long branches); lobules 2 $\frac{1}{2}$ –3 $\frac{1}{2}$  by 2–2 $\frac{1}{2}$  mm, with rather distinct venation, entire or slightly crenate at the margin. *Stamens* inserted 0.7–1.2 mm above the corolla-base; filament 0.7–1 mm long, 0.4 mm broad at the base; anther 1.3–1.6 mm long, 0.7–0.8 mm broad, 0.5–0.6 mm thick, acuminate (sterile acumen 0.3 mm) at the apex, cordate at the base. *Ovary* 0.7–1.2 by 0.8–1.3 mm, densely short-stellate-hirsute for the upper part, glabrous for lower 0.2–0.7 mm; stigma conical, with 5 distinct ridges. *Fruit* obpyriform, 38 by 22 mm, dark brown or dark reddish brown, with dense very short indumentum. Cotyledons plain.

*Distr.* Peninsular Burma, *Malaysia:* Malay Peninsula (Perak, Pahang).

*Ecol.* In dense jungle up to 1200 m.

**34. *Erycibe hellwigii*** PRAIN, J. As. Soc. Beng. 63, 2 (1894) 84, in note; SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 518, p.p.—*E. paniculata* (non ROXB.) WARB. Bot. Jahrb. 13 (1891) 413, p.p.

Scandent shrub or large liana, younger branches stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* subcoriaceous, elliptic to ovate or oblong, (2 $\frac{1}{2}$ –)4–8(–11) by (1–)2–4 $\frac{1}{2}$  (–6 $\frac{1}{2}$ ) cm, 5–7-nerved, rounded to obtuse, rarely to acuminate at the apex, obtuse to rounded,

sometimes slightly cordate at the base; rather densely stellate-hirsute, soon glabrescent, with sunken midrib, faintly sunken to faintly raised nerves, and indistinct to faintly raised nerves above; densely stellate-hirsute, soon glabrescent, with faintly sunken to slightly raised nerves and venation beneath. Petiole 4–10 mm. *Inflorescences* axillary, sometimes 2 together, 1 $\frac{1}{2}$ –12 $\frac{1}{2}$  cm, 10–50-flowered. Pedicel 1 $\frac{1}{2}$ –4 mm. *Sepals* 1 & 2 oval to orbicular, 1.7–1.8 by 1.7 mm, 4 & 5 orbicular, 1.6 by 1.6 mm, to transverse-oval, 1.5–1.6 by 2–2.2 mm, densely stellate-hirsute outside (hairs with 4–7 subequal, up to 300  $\mu$  long branches). *Corolla* 5–6 mm, tube 1.2–2 mm; midpetaline field 2.5 by 1.8–2 mm, rather densely stellate-hirsute (hairs with 4–8 unequal branches, the largest up to 700  $\mu$  long); lobules 1.7–2.8 by 1.6–2 mm, without distinct venation, entire, sometimes coherent above the midpetaline field for up to 1 mm. *Stamens* inserted 0.7 mm above the corolla-base; filament 0.6 mm long, 0.3 mm broad at the base; anther 0.7–0.9 mm long, 0.5 mm broad, 0.4 mm thick, obtuse at the apex, cordate at the base. *Ovary* 0.9 by 0.7 mm, glabrous in the lower 0.4–0.6 mm, stellate-hirsute for upper part; stigma conical, with 5 distinct and 5 low ridges. *Fruit* ovoid, 15 by 13 mm, orange-red or bronze-yellow. Cotyledons plain.

*Distr. Malaysia:* E. New Guinea.

*Ecol.* In forests from sea-level up to 700 m.

**35. *Erycibe timorensis*** HALLIER f. ex HOOGL. Blumea 7 (1953) 318.—*E. rheedii* (non BL.) SPANOGHE, Linnaea 15 (1841) 325.

Woody climber, younger branches densely stellate-hirsute, older ones with distinct longitudinal cork-ridges. *Leaves* elliptic-oblong to oblong or ovate-oblong, 4–10 $\frac{1}{2}$  by 1.8–3.6 cm, 6–8-nerved; acuminate from an obtuse to acute apex, obtuse to rounded at the base; densely stellate-hirsute, soon glabrescent, with slightly sunken midrib and faintly to distinctly prominent nerves and venation above; densely stellate-hirsute, glabrescent (indumentum rather long persistent along midrib and nerves), with prominent nerves and venation beneath. Petiole 5–7 mm. *Inflorescences* axillary, 2–12 cm, 5–25-flowered. Pedicel 1–2 mm. *Sepals* transverse-oval, 1 & 2 2–2.3 by 2.4–2.5 mm, 4 & 5 1.9–2 by 2.3 mm, densely stellate-hirsute outside (hairs with 4–7 subequal, up to 250  $\mu$  long branches). *Corolla* 6 $\frac{1}{2}$  mm, tube 2 mm; midpetaline field 3 $\frac{1}{2}$  by 2 mm, rather densely appressed-hairy (hairs 4–6-branched, branches subequal or one faintly longer and stronger, up to 550  $\mu$  long); lobules 2.5 by 2.7 mm, rather thin, with faintly distinct venation, faintly crenulate at margin, coherent above midpetaline field for 0.8 mm. *Stamens* inserted 0.6 mm above the corolla-base; filament 1.2 mm long, 0.4 mm broad at the base; anther 1 mm long, 0.5 mm broad, 0.4 mm thick, acute at the apex, faintly cordate at the base. *Ovary* 1.2 by 0.9 mm, glabrous for the lower 0.8 mm, stellate-hirsute for the upper part; stigma conical, with 10 distinct ridges. *Fruit* unknown.



Distr. *Malaysia*: Lesser Sunda Islands (Timor).  
Ecol. In the mountains.

mediate not localized Bornean collection is  
MOTLEY 6.

**36. *Erycibe borneensis* (MERR.) HOOGL.** *Blumea* 7 (1953) 310.—*Fissipetalum borneense* MERR. J. Str. Br. R. As. Soc. 85 (1922) 168; Pl. Elm. Born. (1929) 58.

#### KEY TO THE VARIETIES

1. Leaves 9–22 by  $3\frac{1}{2}$ –9 cm. Sepals very sparsely stellate-hirsute outside (branches of the hairs up to 200  $\mu$  long) . . . . . *var. borneensis*
1. Leaves 8–12 by  $2\frac{1}{2}$ –5 cm. Sepals rather densely stellate-hirsute outside (branches of the hairs up to 500  $\mu$  long) . . . . . *var. collina*

*var. borneensis*.

Shrub or small tree, up to 5 m by  $7\frac{1}{2}$  cm, younger branches densely stellate-hirsute, older ones terete, with very few orbicular lenticels, sometimes with some longitudinal slightly corky ridges. *Leaves* subcoriaceous, oblong, 9–22 by  $3\frac{1}{2}$ –9 cm, 6–8-nerved; acuminate from an obtuse apex, obtuse to acutish at the base; rather sparsely stellate-hirsute, soon glabrescent, with slightly sunken midrib, faintly sunken nerves, and indistinct venation above; rather densely stellate-hirsute, glabrescent, with slightly prominent nerves and faintly prominent to indistinct venation beneath. Petiole 5–10 mm. *Inflorescences* axillary, up to 2 cm, (1–)2–12-flowered. Pedicel 1–2 mm. *Sepals* 1 & 2 orbicular, 2.2–2.3 by 2.2–2.3 mm, 4 & 5 transverse-oval, 2.2–2.3 by 2.6–2.8 mm, 1 & 2 very sparsely stellate-hirsute (hairs with 3–6 subequal, up to 200  $\mu$  long branches), 4 & 5 glabrous outside. *Corolla* 8–8½ mm, tube 2 mm; midpetaline field 3.2–4 by 1.6–1.9 mm, rather sparsely stellate-hirsute, in the lower part (1–2 mm) only along the margin (hairs (3–)4–7(–8)-branched, branches subequal or, usually, one stronger and longer, up to 500  $\mu$  long); lobules 3.2–4 by 2–2.5 mm, rather thin, with slightly distinct venation, entire. *Stamens* inserted 0.8–1 mm above the corolla-base; filament 1–1.2 mm long, 0.4–0.5 mm broad at the base; anther 1–1.3 mm long, 0.6–0.8 mm broad, 0.5 mm thick, acute to obtuse at the apex, slightly cordate at the base. *Ovary* ovoid, 1.1–1.7 by 1–1.7 mm, glabrous; stigma conical, with 5 distinct and 5 rather low ridges. Fruit unknown.

Distr. *Malaysia*: Borneo (mainly collected in Br. N. Borneo).

Ecol. In lowland forest.

*var. collina* HOOGL. *Blumea* 7 (1953) 310.

Shrub-like tree, up to 12 m by 30 cm. Leaves 8–12 by  $2\frac{1}{2}$ –5 cm. Sepals rather densely stellate-hirsute outside (branches up to 500  $\mu$  long).

Distr. *Malaysia*: Borneo (Mt Kinabalu in Br. N. Borneo and Mt Irekan in Sarawak).

Ecol. In forests from 600 to 1200 m.

Note. *Var. collina* differs slightly from *var. borneensis* by the characters given above. The leaves are usually rather silvery shining (like in *E. glomerata* BL.) in *var. collina*. A single inter-

**37. *Erycibe aenea* PRAIN, J. As. Soc. Beng. 58, 2 (1894) 85; *ibid.* 74, 2 (1906) 295; RIDL., Fl. Mal. Pen. 2 (1923) 446; BURK. Dict. (1935) 943.**

Liana, up to 50 m by 10 cm, young branches stellate-hirsute, older ones rather smooth with few to many orbicular lenticels. *Leaves* coriaceous, elliptic-oblong to oblong, ca 6–15 by  $2\frac{1}{2}$ –7 cm, 4–6(–7)-nerved; acuminate at the apex, obtuse to rounded at the base; glabrous, with slightly sunken midrib, nerves, and major venation, usually indistinct minor venation above; glabrous, with slightly sunken to slightly prominent nerves and distinctly sunken venation beneath; margin slightly recurved. Petiole 5–8 mm. *Inflorescences* axillary, 1–4 cm, (1–)2–5(–10)-flowered. Flowers very fragrant. Pedicel 1 mm. *Sepals* 1 & 2 about orbicular to transverse-oval, 2–2.3 by 2.5–2.8 mm, 4 & 5 transverse-oval, 2–2.5 by 3–3.5 mm, densely stellate-hirsute outside (hairs with 5–11 subequal, up to 300  $\mu$  long branches, pale brown when dry). *Corolla* light or bright yellow, 7–8½ mm, tube 2–2½ mm; midpetaline field 3.3–4 by 2.3–2.4 mm, lower part stellate-hirsute (hairs with 5–10 subequal, up to ca 250  $\mu$  long branches), upper part appressed-hairy (hairs with 4–8 branches, one distinctly longer and stronger, up to 750  $\mu$  long); lobules 3–4 by 2.8–3.5 mm, entire, coherent above the midpetaline field for  $1\frac{1}{2}$  mm. *Stamens* inserted 0.7–0.8 mm above the corolla-base; filament 0.6–0.7 mm long, 0.5–0.7 mm broad at base; anther 0.8–1 mm long, 0.6–0.8 mm broad, 0.4 mm thick, acuminate (sterile acumen 0.2 mm) at the apex, slightly cordate at the base. *Ovary* 1 by 1–1.3 mm, glabrous or shortly hirsute at the extreme apex; stigma conical, with 10 ridges. *Fruit* ellipsoid or obpyriform with rounded apex and base, 24 by 17 mm, with scurfy surface. Cotyledons plain.

Distr. *Malaysia*: Sumatra and Malay Peninsula.

Ecol. In open jungle up to 750 m.

Vern. *Langsat hutan*, Pahang (= woodland *Lansium*).

Uses. Medicinal use is unimportant (cf. BURKILL, l.c.).

**38. *Erycibe macrophylla* HALLIER f. Bull. Herb. Boiss. 5 (1897) 741; KOORD. Exk. Fl. Java 3 (1912) 115.**

Climbing shrub, younger branches stellate-hirsute, older ones with few orbicular lenticels. *Leaves* coriaceous, ovate-oblong to obovate-oblong, (10–)14–20 by 6–9 cm, 6–7(–8)-nerved, obtuse to acute, short-acuminate at the apex, rounded to obtuse, rarely acute at the base; rather densely stellate-hirsute, soon glabrescent, with slightly prominent midrib, nerves, and venation above; rather densely stellate-hirsute, glabrescent, with prominent nerves and faintly prominent to indistinct venation beneath. Petiole (6–)10–16 mm. *Inflorescences* terminal or axillary,  $1\frac{1}{2}$ –12 cm, 5–50-flowered. Pedicel  $1\frac{1}{2}$ –5 mm. *Sepals* trans-

verse-oval, 1 & 2 2-2.3 by 3-3.5 mm, 4 & 5 2.3-2.8 by 3.5-4.8 mm, rather sparsely stellate-hirsute (hairs with 4-8 subequal, up to 300  $\mu$  long branches) in basal part outside, all glabrous along margins. *Corolla* 9-11 mm, tube  $2\frac{1}{2}$ -3 mm; mid-petaline field 5-6 by 2.6-3.7 mm, densely appressed-hirsute (hairs with 4-8 branches, one distinctly stronger and longer, up to 600  $\mu$  long); lobules 4-4 $\frac{1}{2}$  by 4-5 mm, rather thin, with rather distinct venation, crenulate at margin. *Stamens* inserted 1-1 $\frac{1}{2}$  mm above the corolla-base; filament 0.8-1 mm long, 0.5-0.7 mm broad at base; anther 1.7-2.1 mm long, 0.4-0.6 mm broad, 0.4-0.5 mm thick, acute at the apex, cordate at the base. *Ovary* 1.5-2 by 1.3-1.6 mm, glabrous; stigma conical, with 5 low ridges. Fruit unknown.

Distr. *Malaysia*: Central Java (Mt Ungaran, coll. JUNGHUHN).

Ecol. In forests.

Note. The species is closely related to *E. rheedii* BL., from which it differs, besides by the indumentum on the outer side of the calyx, by the larger corolla with particularly larger lobules and the thinner lobules in which the venation is distinct. The indumentum on the lower side of the leaves is longer persistent.

**39. *Erycibe citriniflora*** GRIFF. Not. 4 (1854) 284; PRAIN, J. As. Soc. Beng. 73, 2 (1904) 17; RIDL, Fl. Mal. Pen. 2 (1923) 445; KERR, Fl. Siam. En. 3 (1951) 94.—*E. glomerata* WALL. [Cat. (1828) no 1338, *nomen*] ex CHOISY, Ann. Sc. Nat. II, 1 (1834) 224; DC. Prod. 9 (1845) 465; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 85, *non* BL. 1826.—*E. wallichii* PRAIN & HALLIER f. ex HALLIER f. Bull. Herb. Boiss. 5 (1897) 382, 738; PRAIN, J. As. Soc. Beng. 73, 2 (1904) 17.—*E. hololobula* KERR, Kew Bull. 1941, 11; Fl. Siam. En. 3 (1951) 96.

Woody climber or scrambling shrub, younger branches stellate-hirsute, older ones with rather many orbicular to oval lenticels. *Leaves* coriaceous, oblong or elliptic-oblong to obovate-oblong or obovate, 8-23(-30) by 3 $\frac{1}{2}$ -9(-11) cm, 8-12-nerved; obtuse to rounded, usually short-acuminate at the apex, acute to obtuse to rounded, sometimes minutely cordate at the base; sparsely stellate-hirsute, soon glabrescent, with faintly prominent to distinctly sunken midrib, nerves, and venation above; densely stellate-hirsute, glabrescent or not, with prominent nerves and venation beneath. Petiole 7-15 mm. *Inflorescences* axillary, sometimes 2 together,  $\frac{1}{2}$ -4 cm, 2-20-flowered. Flowers fragrant. Pedicel 1 $\frac{1}{2}$ -3 mm. *Sepals* 1 & 2 oval to orbicular, 2.5-3.7 by 2.5-3.7 mm, 4 & 5 transverse-oval, 2.5-3.7 by 3-5 mm, stellate-hirsute outside (hairs with 3-7 branches, one distinctly longer and stronger, up to ca 750  $\mu$  long). *Corolla* yellow or cream-coloured, 7 $\frac{1}{2}$ -9 mm, tube 2 $\frac{1}{2}$ -4 mm; midpetaline field 3.5-5 by 2.3-2.8 mm, rather densely appressed-hairy (hairs with 3-8 branches, one distinctly longer and stronger, up to 800  $\mu$  long); lobules 2 $\frac{1}{2}$ -4 by 3-4 mm, rather thick, without or with faintly visible venation, entire, sometimes coherent above the

midpetaline field for up to 0.7 mm. *Stamens* inserted 0.7-1.5 mm above the corolla-base; filament 0.3-0.7 mm long, 0.6-0.8 mm broad at base; anther 1.7-2 mm long, 0.6-1 mm broad, 0.4-0.5 mm thick, acute to acuminate at the apex (sterile part 0.3-0.6 mm), cordate at the base. *Ovary* 1-1.5 by 1.2-1.8 mm, glabrous or densely short-hirsute; stigma conical, with 10 distinct ridges. *Fruit* ellipsoid, 22 by 14 mm, glabrous or rather sparsely short-appressed-hairy. Cotyledons plain.

Distr. Lower Burma, S. Siam, in *Malaysia*: Malay Peninsula (Kedah, Penang).

Ecol. At low altitudes up to 300 m.

Vern. *Kion, kakit*, Peninsular Siam.

**40. *Erycibe rheedii*** BL. Bijdr. 16 (1826) 1047; G. DON, Gen. Syst. 4 (1838) 392; KOORD. Exk. Fl. Java 3 (1912) 115; K. & V. Bijdr. 13 Booms. Java (1914) 33; OOSTSTR. in BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 191, 9.—*E. paniculata* (*non* ROXB.) MIQ. Fl. Ind. Bat. 2 (1856) 1032.—*E. angulata* PRAIN, J. As. Soc. Beng. 63, 2 (1894) 84; *ibid.* 74, 2 (1906) 291; RIDL, Fl. Mal. Pen. 2 (1923) 448; BURK. Dict. (1935) 943.

Large climber or creeper, up to 20 m long, rarely a small, crooked tree, younger branches stellate-hirsute, older ones with few orbicular lenticels. *Leaves* thick subcoriaceous, elliptic-oblong to oblong or obovate-oblong, (7 $\frac{1}{2}$ -)12-24(-30) by (3 $\frac{1}{2}$ -)5 $\frac{1}{2}$ -10(-14) cm, (5-7-11-nerved; rather shortly acuminate from an obtuse apex, obtuse to rounded or slightly cordate at the base; glabrous, with faintly prominent midrib, nerves, and venation above; sparsely stellate-hirsute, soon glabrescent, with prominent nerves and slightly prominent venation beneath. Petiole 8-15 mm. *Inflorescences* terminal, often with some leaves in basal part, downward passing into axillary, 1-23 cm, 5-200-flowered. Pedicel 1 $\frac{1}{2}$ -5 mm. *Sepals* 1 & 2 broadly ovate to orbicular or transverse-oval, 2.3-3.2 by 2-4.2 mm, 4 & 5 transverse-oval, 1.8-3.1 by 2.5-4.5 mm, rather densely stellate-hirsute outside (hairs with (3-4-6(-8) subequal, up to 250  $\mu$  long branches). *Corolla* white or cream-coloured, 7-9 mm, tube 2-3 mm; midpetaline field 3-4 by 1.8-2.8 mm, rather densely stellate-hirsute (hairs with (3-4-6(-8) branches, subequal, up to 200  $\mu$  long, or one stronger branch up to 400  $\mu$  long); lobules 2.2-3.5 by 2.2-3.5 mm, rather thick, without distinct venation, slightly crenate at margin. *Stamens* inserted 0.8-1.2 mm above the corolla-base; filament 0.7-1 mm long, 0.5-0.8 mm broad at the base; anther 1.9-2.5 mm long, 0.7-0.9 mm broad, 0.5-0.6 mm thick, acuminate (sterile acumen 0.3-0.8 mm) at the apex, cordate at the base. *Ovary* 1-2 by 0.8-2 mm, glabrous or lower part glabrous, upper part stellate-hirsute; stigma conical, with 10 distinct ridges. *Fruit* ellipsoid, 20 by 12 mm, dirty yellow-brownish or blue, glabrous or with some stellate hairs near apex. Cotyledons plain.

Distr. *Malaysia*: Sumatra, Malay Peninsula, W. Java, and Br. N. Borneo.

Ecol. In scrub, young forest, or swampy forest at low altitudes (100-250 m).

Vern. *Olor bahai*, Simalur, *panawar ganggang*, Palembang, *akar tampang ari*, *tampang ari*, *tampang ular ari*, *rumpul ular ari*, Mal. Pen.

Uses. Medicinal use is unimportant (cf. BURKILL).

Note. *E. macrophylla* HALLIER f. is a closely related species; cf. under that species.

**41. *Erycibe expansa* WALL.** [Cat. (1828) no 1331, *nomen*] ex G. DON, Gen. Syst. 4 (1837) 392; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 181; PRAIN, J. As. Soc. Beng. 63, 2 (1894) 84; *ibid.* 74, 2 (1906) 289; RIDL. Fl. Mal. Pen. 2 (1923) 445; KERR, Fl. Siam. En. 3 (1951) 95.—*E. paniculata* var. *expansa* CHOISY in DC. Prod. 9 (1845) 464; MIQ. Fl. Ind. Bat. 2 (1859) 1032.—*E. ferruginosa* GRIFF. Not. 4 (1854) 283.

Woody climber, younger branches stellate-hirsute, older ones with distinct longitudinal cork-ridges. Leaves oval to elliptic-ovate,  $2\frac{1}{2}$ –8 by  $1\frac{1}{2}$ –5 cm, 3–4(–5)-nerved; obtuse to acute, often slightly acuminate at the apex, obtuse to rounded, sometimes minutely cordate at the base; rather sparsely stellate-hirsute, glabrescent, with slightly sunken midrib and slightly raised nerves and venation above; stellate-hirsute, indumentum rather long persistent, with slightly prominent nerves and venation beneath. Petiole 3–7 mm. Inflorescences terminal, usually with some leaves in the basal part, upward often with reduced leaves along the axis, 4–30 by  $1\frac{1}{2}$ –10 cm, 10–250-flowered. Flowers fragrant. Pedicel 1–2 mm. Sepals oval, 2.6–3 by 2.2–2.5 mm, densely stellate-hirsute outside (hairs with 3–5 branches, subequal or one longer up to 500  $\mu$  long). Corolla white,  $7\frac{1}{2}$ – $9\frac{1}{2}$  mm, tube  $2\frac{1}{2}$  mm; midpetaline field 3.5–4.5 by 2–2.4 mm, densely appressed-hairy (hairs mainly 3-branched, few with 2 or more branches, generally one stronger, up to 900  $\mu$  long branch); lobules 2.8–4 by 2.5–3.5 mm, rather thick, without distinct venation, entire. Stamens inserted 1 mm above the corolla-base; filament 0.7–0.8 mm long, 0.3–0.4 mm broad at the base; anther 1.5–1.7 mm long, 0.8 mm broad, 0.7 mm thick, acuminate at the apex (sterile acumen 0.6–0.7 mm), slightly cordate at the base. Ovary 0.8 by 1 mm, glabrous; stigma conical, with 5 distinct ridges. Fruit ellipsoid, 12 by 6 mm, glabrous. Cotyledons plain.

Distr. Lower Burma (from Moulmein S. wards), Peninsular Siam, ?Nicobar Islands, in Malaysia: Malay Peninsula (N. part, S. to Penang).

Ecol. In scrub at low altitude.

Vern. *Lin sua*, *sai ma*, *yan pao kûn*, Peninsular Siam.

Uses. The stems are used by fishermen for ropes (Tavoy).

Note. A closely related species, not found in Malaysia, is *E. peguensis* (CLARKE) PRAIN from Northern Burma (Chittagong to Moulmein), Northern Siam, and the Andaman and Nicobar Islands. The only record of the present species from the Nicobar Islands is a badly labelled old fragmentary specimen.

**42. *Erycibe tomentosa* BL.** Bijdr. 16 (1826) 1048; DC. Prod. 9 (1845) 464; MIQ. Fl. Ind. Bat. 2 (1859) 1033; KOORD. Exk. Fl. Java 3 (1912) 115; OOSTSTR. in BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 191, 8.—*E. princii* WALL. [Cat. (1828) no 1335, '*princei*', *nomen*] ex CHOISY, Ann. Sc. Nat. II, 1 (1834) 223; DC. Prod. 9 (1845) 464; MIQ. Fl. Ind. Bat. 2 (1859) 1033; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 182; PRAIN, J. As. Soc. Beng. 63, 2 (1894) 85; *ibid.* 74, 2 (1906) 290; MERR. En. Born. (1921) 508; En. Philip. 3 (1923) 358; RIDL. Fl. Mal. Pen. 2 (1923) 446; BURK. Dict. (1935) 944; HENDERS. Mal. Wild Flowers 2 (1950) 313, f. 295.—*E. camptobotrya* MIQ. Fl. Ind. Bat. Suppl. (1861) 248, 578.—*E. parvifolia* HALLIER f. Bull. Herb. Boiss. 5 (1897) 738, 739.—*E. hirsuta* HALLIER f. Bot. Jahrb. 49 (1913) 376; MERR. En. Born. (1921) 508.—*E. dolichotricha* MERR. Pap. Mich. Acad. Sc. Arts & Lett. 19 (1934) 189.—**Fig. 18.**

#### KEY TO THE VARIETIES

1. Leaves ovate-, elliptic-, or obovate-oblong, 5–14(–18) by  $2\frac{1}{2}$ – $5\frac{1}{2}$ (– $8\frac{1}{2}$ ) cm, 5–8-nerved. Sepals outside with 2–5-branched hairs with subequal, up to 500  $\mu$  long branches. Midpetaline field with hairs with one stronger, up to 1500  $\mu$  long branch . . . var. *tomentosa*
1. Leaves ovate or ovate-oblong, 4–9 by  $1\frac{1}{2}$ –4 cm, 5–6-nerved. Sepals outside with 2–4-branched hairs with one stronger, up to 1000  $\mu$  long branch. Stronger branch of hairs of midpetaline field up to 2000  $\mu$  long . . . var. *hirsuta*

var. *tomentosa*.—*E. tomentosa* BL. 1826.—*E. princii* WALL. ex CHOISY 1834.—*E. camptobotrya* MIQ. 1861.—*E. parvifolia* HALLIER f. 1897.—**Fig. 18.**

Creeper, climber, up to 25 m long, or shrub, up to 3 m high, younger branches densely stellate-hirsute, glabrescent, older ones with distinct longitudinal cork-ridges. Leaves ovate-oblong, elliptic-oblong, or obovate-oblong to oblong, 5–14(–18) by  $2\frac{1}{2}$ – $5\frac{1}{2}$ (– $8\frac{1}{2}$ ) cm, 5–8-nerved; broad-acute to rounded, usually distinctly acuminate at the apex, obtuse to rounded, usually slightly cordate at the base; densely stellate-hirsute, soon glabrescent, with slightly sunken midrib and faintly prominent to, rarely, slightly sunken nerves and venation above; densely stellate-hirsute, glabrescent, with slightly prominent nerves and slightly to faintly prominent venation beneath. Petiole 3–5(–6) mm. Inflorescences axillary, near the apex of the branches passing into terminal, 1–4, terminal ones up to 7 cm long, 3–15(–25)-flowered. Pedicel  $1\frac{1}{2}$ –3 mm, with small rather broad caducous bracteoles. Sepals 1 & 2 orbicular to transverse-oval, 3.5–4.8 by 3.7–5 mm, 4 & 5 transverse-oval, 3.5–4 by 4.2–5 mm, rather sparsely stellate-hirsute outside (hairs with 2–5 subequal, up to 500  $\mu$  long branches). Corolla white, 7–9 mm, tube  $2\frac{1}{2}$ –3 mm; midpetal-



Fig. 18. *Erycibe tomentosa* BL. var. *tomentosa*.—a. Flowering branch,  $\times \frac{3}{4}$ , b. fruiting branch,  $\times \frac{3}{4}$ , c. flower from aside,  $\times 2$ , d. one of two outer, e. one of two inner sepals,  $\times 4$ , f. corolla-lobes from inside,  $\times 3$ , g. ovary, lateral view,  $\times 7\frac{1}{2}$ , h. stigma, apical view,  $\times 7\frac{1}{2}$ , j. ovary, longitudinal section,  $\times 7\frac{1}{2}$ , k. fruit, transverse section,  $\times 2$ .

ine field 3.7–4.3 by 2.2–2.8 mm, densely appressed-hairy (hairs 2–4-branched with one stronger and longer, up to 1500  $\mu$  long branch) with generally (in dry state)  $\pm$  orange coloured hairs; lobules 2.7–3.2 by 3–4 mm, rather thick, without distinct venation, slightly crenate at margin, coherent above the midpetaline field for 1–1 $\frac{1}{2}$  mm. *Stamens* inserted at 0.8–1.2 mm above the corolla-base; filament 1–1.4 mm long, 0.4–0.5 mm broad at the base; anther 1.3–2 mm long, 0.6–0.8 mm broad, 0.4–0.5 mm thick, acute to acuminate at the apex, cordate at the base. *Ovary* 1–1.2 by 1.3–1.5 mm, glabrous; stigma conical, with 5 distinct ridges. *Fruit* ellipsoid to ovoid, 12 by 7 mm, glabrous, smooth, orange to red, at maturity black. Cotyledons plain.

Distr. *Malaysia*: Sumatra, Malay Peninsula, W. Java, Madura, Kangean Islands, Borneo, Philippines (Leyte).

Ecol. In scrub or forest, up to 1200 m altitude.

Vern. *Akar kait kait*, *akar tēklibang*, Banka, *akar pērut kijang*, *akar sēkiang*, *akar pēlandok*, *akar pērut kērbau*, *akar ulan jantan*, *jambul siul*, Mal. Pen., *areuy muhmal*, *rhabet kēmpir*, *aroy kikonang*, S, *tuba tuba*, *akar pulut*, Borneo.

Uses. The long slender stems are strong enough to be used for binding fences.

*var. hirsuta* (HALLIER f.) HOOGL. *stat. nov.*—*E. hirsuta* HALLIER f. 1913.—*E. dolichotricha* MERR. 1934.

Differs from *var. tomentosa* by the following characters:

*Leaves* smaller, ovate-oblong or ovate, 4–9 by 1 $\frac{1}{2}$ –4 cm, 5–6-nerved. *Sepals* outside with 2–4 branched hairs, with one stronger up to 1000  $\mu$  long branch. Stronger branch of hairs of midpetaline field up to 2000  $\mu$  long.

Distr. *Malaysia*: Sumatra (E. Coast), Malay Peninsula (Singapore), Borneo, up to 1000 m.

Note. The two varieties have often a marked different habit. The hairs of the younger branches agree with those of the outer side of the sepals, and give in *var. hirsuta* the branches a strongly hirsute appearance. A few collections are more or less intermediate between the two varieties.

**43. *Erycibe grandiflora* ADELB. in HOOGL. Blumea 7 (1953) 313.**

Scandent shrub or liana. Branches densely stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* subcoriaceous, ovate to ovate-oblong to oblong, 5–18 by 1 $\frac{1}{2}$ –7 cm, 4–7-nerved; obtuse to acute, usually more or less acuminate at the apex, obtuse to rounded, sometimes slightly cordate at the base; sparsely stellate-hirsute to nearly glabrous, glabrescent, with slightly sunken midrib and slightly prominent nerves and venation above; stellate-hirsute on the intervenium, rather densely so on the midrib and nerves, rather soon glabrescent, with slightly prominent nerves and venation beneath. Petiole 5–7 mm. *Inflorescences* axillary, near the end of the branches sometimes passing into terminal, then often with some leaves in basal part, 1 $\frac{1}{2}$ –4

(–10) cm, 8–50-flowered. Pedicel 1 $\frac{1}{2}$ –4 mm. *Sepals* orbicular to transverse-oval, 3.8–5 by 4–5 mm, rather densely stellate-hirsute outside (hairs with 3–6 subequal, up to 500  $\mu$  long branches). *Corolla* creamy white, light yellowish, or light greenish, 9–10 mm, tube 3–4 mm; midpetaline field 4.3–5 by 2.8–3.2 mm, rather densely appressed-hairy (hairs usually with strong central branch, up to 1300  $\mu$  long, and 1–3 smaller basal branches); lobules 3.2–3.5 by 2.5–4 mm, without distinct venation, slightly crenulate or undulate at the margin. *Stamens* inserted 0.8–1.2 mm above the corolla-base; filament 0.8–1 mm long, 0.5–0.6 mm broad at the base; anther 1.6 mm long, 0.6–0.8 mm broad, 0.5–0.7 mm thick, narrowly acute at the apex (sterile for 0.2–0.6 mm), cordate at base. *Ovary* 0.8–1 by 1.7–1.8 mm, glabrous; stigma conical, with 5 densely warty ridges. *Fruit* ovoid, 1 $\frac{1}{2}$  by 1 cm, glabrous, smooth, bright red. Cotyledons plain.

Distr. *Malaysia*: New Guinea (Biak, Hollandia, and the Sepik region).

Ecol. In second growth scrub vegetation (Biak), at low altitude.

**44. *Erycibe beccariana* HOOGL. Blumea 7 (1953) 310.**

Liana, younger branches rather sparsely stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* subcoriaceous, elliptic to elliptic-oblong, 9–15 by 4–7 $\frac{1}{2}$  cm, 8–10-nerved; slightly acuminate at the apex, obtuse to rounded, sometimes slightly cordate at the base; glabrous, with slightly sunken midrib and prominent nerves and venation above; sparsely stellate-hirsute, soon glabrescent, with prominent nerves and slightly prominent venation beneath. Petiole 8–13 mm. *Inflorescences* axillary, 1–2 cm, 6–12-flowered. Pedicel 2–4 mm. *Sepals* transverse-oval, 1 & 2 ca 2.5 by 3–3.2 mm, 4 & 5 2.7–2.8 by 4.5–5 mm, stellate-hirsute outside (hairs with 3–5 subequal, up to 400  $\mu$  long branches). *Corolla* 8 $\frac{1}{2}$  mm, tube 2 $\frac{1}{2}$  mm; midpetaline field 4 by 3 mm, densely appressed-hairy (hairs 4–6-branched, often one branch stronger, up to 700  $\mu$  long); lobules 3.6 by 3 mm, without distinct venation, undulate at the margin. *Stamens* inserted 1–1.2 mm above the corolla-base; filament 1.5–1.7 mm long, 0.5–0.6 mm broad at the base; anther 2.2–2.3 mm long, 0.9–1 mm broad, 0.8 mm thick, acuminate (sterile acumen 0.5–0.6 mm) at the apex, slightly cordate at the base. *Ovary* 1–1.1 by 1.8 mm, glabrous; stigma conical, with 5 rather distinct and 5 faint ridges. *Fruit* ellipsoid, 22 by 9 mm, glabrous, smooth. Cotyledons plain.

Distr. *Malaysia*: W. New Guinea (Vogelkop).

**45. *Erycibe malaccensis* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 182; PRAIN, J. As. Soc. Beng. 63, 2 (1894) 85; *ibid.* 74, 2 (1906) 291; RIDL. Fl. Mal. Pen. 2 (1923) 446; BURK. Dict. (1935) 944.—*E. paniculata* (non ROXB.) VIDAL, Rev. Pl. Vasc. Filip. (1886) 195.—*E. dubia* ELM. Leaf. Philip. Bot. 2 (1909) 589; MERR. En. Philip. 3 (1923) 358.—*E. celebica* HALLIER f. in ELBERT, Sunda-Exped. (1912) 286, *nomen*.**

Creeper or climber, up to 30 m, or scandent shrub, up to 3 m, younger branches densely stellate-hirsute, older ones with distinct longitudinal cork-ridges. *Leaves* ovate to elliptic or oblong, 5–16 by  $2\frac{1}{2}$ –6 $\frac{1}{2}$  cm, 4–6(–7)-nerved; obtuse to rounded, generally distinctly acuminate at the apex, obtuse to rounded, sometimes slightly cordate at the base; densely stellate-hirsute, soon glabrescent, with slightly sunken midrib and slightly prominent nerves and venation above; densely stellate-hirsute, soon glabrescent, with prominent nerves and venation beneath. Petiole 5–10 mm. *Inflorescences* axillary, near the apex of the branches passing into terminal,  $1\frac{1}{2}$ –10(–16) cm, 3–15(–20)-flowered. Pedicel 3–10 mm. *Sepals* 1 & 2 orbicular to transverse-oval, 3–4 by 3.2–5 mm, 4 & 5 transverse-oval, 2.7–3.7 by 3.2–5 mm, densely stellate-hirsute outside (hairs with (3–) 4–8 subequal, up to 350  $\mu$  long branches). *Corolla* white, 7–11 mm, tube 2–4 mm; midpetaline field 2.5–6 by 2.4–3.5 mm, rather densely appressed-hairy (hairs (2–)3–5(–7)-branched with generally one distinctly longer and stronger, up to 1400  $\mu$  long branch); lobules  $2\frac{1}{2}$ –4 $\frac{1}{2}$  by  $3\frac{1}{2}$ –5 $\frac{1}{2}$  mm, with invisible to rather distinct venation, entire. *Stamens* inserted 0.8–1.5 mm above the corolla-base; filament 0.8–1.5 mm long, 0.3–0.9 mm broad at base; anther 1.3–1.8 mm long, 0.3–0.9 mm broad, 0.3–0.6 mm thick, acuminate (sterile acumen 0.3–0.7 mm) at the apex, cordate at the base. *Ovary* 0.7–1.5 by 1.2–1.7 mm, glabrous; stigma conical, with 5 distinct and, sometimes, 5 low ridges. *Fruit* ellipsoid, 16 by 14 mm, glabrous, smooth, red. Cotyledons plain.

Distr. *Malaysia*: Malay Peninsula, Philippines, Celebes, and TW. Java (ZOLLINGER).

Ecol. In open jungle or in primary forest, from low altitude up to 500 m.

Vern. *Akar perut kijang jantan*, *akar sèkiang*, *akar sèrawan jantan*, Malay Peninsula; Philippines: *balisaog*, *malutai*, Tag., *saladai*, Bis.; *kakuwasa*, *tjapungongo*, Celebes.

Uses. Medicinal use unimportant (cf. BURKILL).

Note. The species is extremely variable as to size and form of the leaves. The specimens from the Malay Peninsula have generally rather small leaves, those from Celebes rather large leaves, while both small- and large-leaved specimens are found in the Philippines. The species is strongly characterized in the herbarium by the yellowish colour of the indumentum and the distinct venation of the lower surface of the leaves.

**46. *Erycibe clemensae* OOSTSTR.** J. Arn. Arb. 29 (1948) 416, f. 1 & pl. 1.

Shrub or liana, younger branches stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* subcoriaceous, ovate or elliptic to oblong or ovate-oblong, 5–12 by ( $1\frac{1}{2}$ –)2–5 $\frac{1}{2}$  cm, 5–8-nerved; obtuse or slightly acuminate at the apex, obtuse, sometimes minutely cordate at the base; rather sparsely stellate-hirsute, soon glabrescent, rather glossy, with sunken midrib and faintly prominent to slightly sunken nerves and venation above;

densely stellate-hirsute, rather soon glabrescent, with prominent nerves and venation beneath. Petiole 5–10 mm. *Inflorescences* axillary, sometimes 2 together, 3–9 cm, 10–40-flowered. Pedicel  $1\frac{1}{2}$ –4 mm. *Sepals* transverse-oval, 1 & 2 2–2.5 by 2.3–3.2 mm, 4 & 5 1.8–2.3 by 2.1–3 mm, rather densely stellate-hirsute outside (hairs with 3–8 subequal, up to 300  $\mu$  long branches). *Corolla* cream-yellowish,  $6\frac{1}{2}$ –8 $\frac{1}{2}$  mm, tube  $1\frac{1}{2}$ –2 mm; midpetaline field 3–5 by 2–2.8 mm, rather densely stellate-hirsute (hairs with 4–8 branches, usually one stronger and longer, up to 850  $\mu$  long); lobules 2.3–3.5 by 2.4–3 mm, with rather distinct venation, entire. *Stamens* inserted 0.7–0.8 mm above the corolla-base; filament 0.7–1.2 mm long, 0.3–0.5 mm broad at the base; anther 0.8–1 mm long, 0.5–0.7 mm broad, 0.3–0.5 mm thick, obtuse at the apex, slightly cordate at the base. *Ovary* 0.7–1.3 by 0.8–1 mm, glabrous for lower 0.5–0.7 mm, short-hirsute in the upper part; stigma conical, with 5 ridges. Fruit unknown.

Distr. *Malaysia*: E. New Guinea.

Ecol. In forest at 600 m (once noted).

**47. *Erycibe schlechteri* PILGER**, Bot. Jahrb. 59 (1924) 85.

Scandent, younger branches densely stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* ovate-oblong to oblong, 5–9 by 2.4–3.3 cm, 4–6-nerved, obtuse to acute, slightly acuminate at the apex, obtuse to rounded at the base; rather densely stellate-hirsute, soon glabrescent, with very slightly sunken midrib and indistinct to faintly prominent nerves and venation above; densely stellate-hirsute, rather late glabrescent, with prominent nerves and slightly prominent venation beneath. Petiole 4–6 mm. *Inflorescences* crowded near the end of the branches, about 3 in the axil of each of the one or two upper leaves, 4–8 cm, 20–40-flowered, with small leafy bracts up to 12 by 5 mm along the main branch. Flowers known only in old bud stage. Pedicel 1–3 mm. *Sepals* 1 & 2 obovate, 3 by 2.7 mm, 4 & 5 transverse-oval, 2.6 by 3.2 mm, densely stellate-hirsute outside (hairs 4–6(–7)-branched, branches subequal, sometimes one stronger, up to 700  $\mu$  long branch). *Corolla* (not fully expanded) 6 mm, tube  $1\frac{1}{2}$  mm; midpetaline field 2.5 by 1.8 mm, densely appressed-hairy (hairs with 3–4 branches, generally one branch distinctly longer and stronger, up to 1250  $\mu$  long); lobules 2.2 by 2 mm, without distinct venation, entire. *Stamens* inserted 0.5 mm above the corolla-base; filament 0.3 mm long, 0.5 mm broad at the base; anther 1.5 mm long, 0.6 mm broad, 0.4 mm thick, acuminate (sterile acumen 0.3 mm) at the apex, cordate at the base. *Ovary* 0.8 by 1.3 mm, densely stellate-hirsute over the whole surface; stigma conical, with 5 ridges. Fruit unknown.

Distr. *Malaysia*: NE. New Guinea.

**48. *Erycibe puberula* HOOGL.** Blumea 7 (1953) 316.

Liana, younger branches stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* elliptic-oblong to oblong, 6–14 by 3–8 cm, 6–7-nerved,

obtuse, often slightly acuminate at the apex, obtuse at the base; glabrous, with slightly prominent midrib and faintly prominent nerves and venation above; densely stellate-hirsute on midrib and nerves, glabrescent on nerves, glabrous on the intervenium, with sharply prominent nerves and slightly prominent venation beneath. Petiole 8–15 mm. *Inflorescences* axillary, near the end of the branches sometimes passing into terminal, (2½–)4–10 cm, (10–)25–80-flowered. Pedicel 1–4 mm. *Sepals* 1 & 2 orbicular, 2.5 by 2.5 mm, 4 & 5 transverse-oval, 2.2 by 2.7 mm, densely stellate-hirsute outside (hairs with 5–8 subequal, up to 200 µ long branches). *Corolla* 6 mm, tube 2 mm; midpetaline field 2.5 by 1.8 mm, rather densely stellate-hirsute (hairs with 3–5 branches, usually one stronger and longer, up to 450 µ long); lobules 2 by 2½–3 mm, without distinct venation, crenulate at the margin. *Stamens* inserted ½ mm above the corolla-base; filament 0.8 mm long, 0.4 mm broad at the base; anther 1.2 mm long, 0.7 mm broad, 0.4 mm thick, acuminate (sterile acumen 0.5 mm) at the apex, cordate at the base. *Ovary* 0.7 by 1.2 mm, lower half glabrous, upper half slightly stellate-hirsute; stigma conical, with 5 more or less distinct ridges. *Fruit* ellipsoid, 18 by 10 mm, glabrous except few hairs near the apex. Cotyledons plain.

Distr. *Malaysia*: NW. New Guinea (twice collected near Bernhard bivouac).

Ecol. In forest, 50 and 1200 m altitude.

**49. *Erycibe brassii* HOOGL.** Blumea 7 (1953) 311.

Liana, young branches stellate-hirsute, older ones with distinct longitudinal cork-ridges. *Leaves* rather thin, elliptic-oblong to ovate-oblong, 7½–16 by 4–6½ cm, 4–7-nerved; obtuse at the base, slightly acuminate at the apex; stellate-hirsute, soon glabrescent, with sunken midrib and slightly prominent nerves and venation above; stellate-hirsute, soon glabrescent, with prominent nerves and venation beneath. Petiole 7–11 mm. *Inflorescences* axillary, 1–2½ cm, 8–12-flowered. Pedicel 2½–4 mm long. *Sepals* subequal, transverse-oval, 2.7 by 3.5 mm, stellate-hirsute outside (hairs with 3–5 subequal, up to 400 µ long branches). *Corolla* waxy yellow, 8 mm, tube 2½ mm; midpetaline field 4 by 2 mm, densely appressed-hairy (hairs mainly 2-, few 3-branched, up to ca 1250 µ total length); lobules 3.8 by 3 mm, without distinct venation, entire. *Stamens* inserted 0.8 mm above the corolla-base; filament 1 mm long, 0.6 mm broad at the base; anther 1.8 mm long, 1 mm broad, 0.7 mm thick, acuminate (sterile acumen 0.5 mm) at the apex, cordate at the base. *Ovary* 1.4 by 1.1 mm, lower 0.8 mm glabrous, upper 0.6 mm stellate-hirsute; stigma conical, with 10 ridges. *Fruit* unknown.

Distr. *Malaysia*: SE. New Guinea (Lower Fly River), once collected.

Ecol. Liana in canopy layer of rain-forest at low altitude.

**50. *Erycibe subglabra* SCHEFF. ex HOOGL.** Blumea 7 (1953) 317.

Scandent shrub, younger branches rather densely stellate-hirsute, soon glabrescent, older ones with distinct longitudinal cork-ridges. *Leaves* elliptic to oblong, 6–13 by 2½–6½ cm, 5–7-nerved; obtuse to acute, usually slightly acuminate at the apex, obtuse to rounded, sometimes slightly cordate at the base; glabrous on both sides; with slightly sunken midrib and slightly prominent nerves and venation above; with prominent nerves and venation beneath. Petiole 6–12 mm. *Inflorescences* axillary, sometimes 2(–3) together, 1½–6 cm, 5–50-flowered. Pedicel 2–4 mm. *Sepals* 1 & 2 orbicular to transverse-oval, 3–3½ by 3–4 mm, 4 & 5 transverse-oval, 3–3.2 by 4–4.2 mm, rather sparsely to rather densely stellate-hirsute outside (hairs with 3–8 subequal, up to 500 µ long branches). *Corolla* yellow, 8 mm, tube 2–3 mm; midpetaline field 2.8–3.5 by 2.5 mm, densely appressed-hairy (hairs (2–)3–6(–9)-branched with generally one stronger, up to 1000 µ long branch); lobules 3–3½ by 3 mm, rather thick, without distinct venation, faintly crenulate at margin. *Stamens* inserted 0.8–1.3 mm above the corolla-base; filament 0.7–1 mm long, 0.8 mm broad at the base; anther 1.9–2 mm long, 0.8–1 mm broad, 0.5–0.6 mm thick, acuminate at the apex (sterile acumen 0.5–0.6 mm), cordate at the base. *Ovary* ellipsoid, 1.2 by 1.7–2.2 mm, glabrous for the lower 0.3–0.4 mm, appressed-hairy for the upper part; stigma conical, with 5 distinct and 5 faint ridges. *Fruit* ellipsoid, 1.7 by 1.1 mm, glabrous except for some hairs at the extreme apex, smooth. Cotyledons plain.

Distr. *Malaysia*: Moluccas (Ceram, Ambon). Ecol. Seashore (once noted).

**51. *Erycibe impressa* HOOGL.** Blumea 7 (1953) 314.

Liana, up to 45 m long, older branches with distinct longitudinal cork-ridges. *Leaves* coriaceous, elliptic-oblong, 7–12 by 3–5 cm; acuminate from an obtuse to broad-acute apex, obtuse at the base; glabrous on both sides; with slightly sunken midrib, nerves, and venation above; with slightly sunken nerves and venation beneath. Petiole 7–14 mm. *Inflorescences* axillary, few-flowered (1–3-fruited), up to 1½ cm long. Flowers unknown. Fruiting pedicel 6–10 mm. *Sepals* (in fruit) transverse-oval, 4 by 5 mm, sparsely strigose outside (hairs 2-branched, up to 400 µ total length). *Fruit* ellipsoid, 17 by 12 mm, glabrous, lower 1½–2/3 part smooth, upper 2/3–1/3 part scurfy. Cotyledons plain.

Distr. *Malaysia*: Br. N. Borneo (Mt Kinabalu), once collected.

Ecol. On edge of jungle at ca 1000 m altitude.

**52. *Erycibe induta* PILGER.** Bot. Jahrb. 59 (1924) 86.

Large liana, younger branches stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* elliptic-oblong, 6–12 by 3–5½ cm, 4–5-nerved, obtuse to subacute, slightly acuminate at the apex, obtuse at the base; rather densely stellate-hirsute, soon glabrescent, with slightly sunken midrib, faintly sunken nerves, and indistinct venation



above; densely stellate-hirsute, later on floccosely glabrescent; indumentum long-persistent along the midrib and nerves, with prominent nerves, faintly prominent major venation, indistinct minor venation beneath. Petiole 5–12 mm. *Infructescences* axillary or terminal, 4–15 cm, 5–40-flowered. Flowers unknown. *Sepals* (in fruit) 1 & 2 orbicular to transverse-oval, 2.3–2.5 by 2.5–2.8 mm, 4 & 5 transverse-oval, 2.1–2.3 by 3 mm, densely stellate-hirsute outside (hairs with 5–8 subequal, up to 200  $\mu$  long branches). *Fruit* ellipsoid, 10 by 7 mm, brown-red, glabrous except some short stellate hairs on the apical part. Cotyledons plain.

Distr. *Malaysia*: E. New Guinea (Sepik region), once collected.

Ecol. In dense forest at low altitude.

**53. *Erycibe zippellii* HOOGL. Blumea 7 (1953) 319.**

Scandent, younger branches rather densely stellate-hirsute, older ones with longitudinal cork-ridges. *Leaves* subcoriaceous, elliptic-oblong, 5–8½ by 2–4½ cm, 4–5-nerved, rounded to obtuse, slightly acuminate at the apex, obtuse at the base; glabrous, with sunken midrib and prominent nerves and venation above; minutely stellate-hirsute, soon glabrescent, with prominent nerves

and indistinct venation beneath. Petiole 6–10 mm. *Infructescences* axillary, sometimes 2 together, up to 6 cm, ca 10(?)-flowered. Flowers unknown. Pedicel (in fruit) 4–6 mm. *Sepals* (in fruit) transverse-oval, 1 & 2 2–2.5 by 3–3.2 mm, 4 & 5 2.2–2.5 by 3–3.7 mm, rather densely stellate-hirsute (hairs with 3–5 subequal, up to 250  $\mu$  long branches). *Fruit* ovoid, 7 by 5 mm, glabrous except for some short stellate hairs near the apex.

Distr. *Malaysia*: W. New Guinea (Triton Bay).

**Excluded**

*E. paniculata* ROXB. has been reported from *Malaysia* several times. This species, however, is restricted to India and close surroundings and has never been collected in *Malaysia*. All records of it appear to refer to other species.

*E. paniculata* var. *coccinea* F. M. BAIL. [*E. coccinea* (F. M. BAIL.) HOOGL.] is endemic in Northern Queensland. It is recorded from New Guinea (Queensl. Agric. J. 23, 1909, 219). I have not seen the specimen on which this record has been based, but I doubt whether it belongs to *E. coccinea*.

**8. JACQUEMONTIA**

CHOISY, Mém. Soc. Phys. Genève 6 (1833) 476; OOSTSTR. Blumea 3 (1939) 267.—Fig. 19–20.

Herbaceous or woody twiners, rarely erect, generally hairy with stellate hairs, very rarely glabrous. *Leaves* mostly petioled, variable in size and shape, often cordate, entire, rarely dentate or lobed. *Flowers* in axillary, mostly peduncled, umbelliform or capitate cymes, with or without an involucre, rarely in scorpioid cymes, or solitary, or in dense terminal spikes or heads. Bracts small, linear to lanceolate, or larger and foliaceous. *Sepals* 5, equal, or more or less unequal, often with larger outer ones. *Corolla* regular, medium-sized or small, funnel-shaped or campanulate, blue, lilac, pink, or rarely white, with 5 distinctly marked midpetaline bands, limb 5-toothed or nearly entire, rarely 5-lobed. Stamens and style included. Stamens 5, filaments adnate to the corolla, filiform. Pollen smooth. Disk small or none. Ovary 2-celled, each cell with 2 ovules; style 1, simple, filiform; stigmas 2, mostly elliptic or oblong and complanate, rarely linear or globose. *Capsule* globose, 2-celled, 4- or usually 8-valved. *Seeds* 4 or less, smooth or minutely papillose, glabrous or velutinous, the dorsal edges often with a narrow scarious wing.

Distr. *Ca* 120 spp., the greater part of which in tropical and subtropical America; a few spp. also in the tropical and subtropical parts of the Old World.

Note. The genus can be subdivided into 4 sections, of which the *Cymosae* MEISSN. (Fl. Bras. 7, 1869, 292, 294) are represented in *Malaysia*.

**KEY TO THE SPECIES**

1. Leaves oblong or lanceolate, narrowed at the base, shortly petioled . . . . . 4. *J. browniana*
1. Leaves ovate, cordate, broadly rounded or truncate at the base; petiole well-developed, slender.
2. Outer sepals longer than inner ones, attenuate or acuminate towards the acute apex (in one variety subobtuse).
3. Stigmas filiform. Bracts small to minute, 5 mm long or less. Corolla *ca* 1 cm long.



4. Two outer sepals ovate-lanceolate to ovate, attenuate to the base, acuminate at the apex (in *var. philippinensis* the outer sepals subobtusate, cuspidate or mucronulate, not distinctly acuminate).
4. Two outer sepals broadly ovate, cordate or rounded at the base, acute to short-acuminate at the apex
3. Stigmas elliptic. Bracts longer, linear, to 10 mm long. Corolla 1½–2 cm long
2. Outer sepals shorter than inner ones, or sepals subequal in length, obtuse.
5. Sepals subequal in length, densely stellately puberulent. Ovary pilose. Stigmas subglobose.
5. Outer sepals shorter than inner, glabrous. Ovary glabrous. Stigmas broadly elliptic to orbicular.

1. *J. paniculata*2. *J. zollingeri*5. *J. pentantha*3. *J. tomentella*6. *J. blanchetii*

1. *Jacquemontia paniculata* (BURM. f.) HALLIER f. Bot. Jahrb. 16 (1893) 541; OOSTSTR. Blumea 3 (1939) 269.—*Ipomoea paniculata* BURM. f. Fl. Ind. (1768) 50, t. 21, f. 3.—*Convolvulus parviflorus* VAHL, Symb. Bot. 3 (1794) 29, non DESR. 1789, nec SALISB. 1796.—*Convolvulus multivalvis* R.Br. Prod. (1810) 483 *var. β.*—*J. umbellata* BOJ. Hort. Maurit. (1837) 229; CHOISY in DC. Prod. 9 (1845) 397.—*Convolvulus valerianoides* BLANCO<sup>1</sup>, Fl. Filip. (1837) 90.—*Convolvulus boerhaavioides* BLANCO<sup>1</sup>, L.c. ed. 2 (1845) 67.—*Breweria valerianoides* F.-VILL<sup>1</sup>. Nov. App. (1880) 143.—*Convolvulus parviflorus* VAHL *var. naumannii* ENGL. Bot. Jahrb. 7 (1886) 472.—*Convolvulus paniculatus* O.K. Rev. Gen. Pl. (1891) 440.—Fig. 19.

## KEY TO THE VARIETIES

1. Three outer sepals elliptic to elliptic-oblong, obtusish, cuspidate to mucronulate, not distinctly acuminate at the apex.
1. Three outer sepals ovate-lanceolate to ovate, acuminate at the apex.
2. Leaves glabrous, or short-pilose and glabrescent above and beneath.
2. Leaves mostly densely tomentose, finally glabrescent.

*var. philippinensis**var. paniculata**var. tomentosa**var. paniculata*.—Fig. 19.

A herbaceous twiner, 1½–2 m; young specimens erect or decumbent. Stems terete, slender, young parts mostly hairy, and mostly glabrescent. *Leaves* ovate or ovate-oblong, 2–8 by 1½–5 cm, more or less cordate or rounded to truncate at the base, mostly acuminate and mucronulate at the apex, or sometimes acute to obtuse, glabrous or shortly pilose and glabrescent above and beneath; lateral nerves 5–8 on either side of the midrib, arcuately connected near the margin; petiole slender, 1–6 cm long, finely pilose. *Peduncles* variable in length, a few mm to several cm, more or less pubescent. Flowers in a loose to very dense few-to many-flowered umbelliform cyme. Pedicels filiform, pubescent, 3–6 mm, or longer in fruit. Bracts small, subulate. *Sepals* pilose or nearly glabrous, unequal; 3 outer ones, of which the third is often more or less oblique, ovate-lanceolate to ovate, 5–7 mm long, attenuate towards the

base, acuminate to long-acuminate at the apex, with a more or less waved acumen, herbaceous, or the third one with a scarious margin at one side; 2 inner ones shorter, 3–4½ mm long, with a broad-ovate to orbicular basal part with scarious margins, acuminate at the apex. *Corolla* funnel-shaped, 8–10 mm long, lilac, pale blue, pale pink, often paler to white at the base, or entirely white, 5-lobed, glabrous, or with a few hairs at the mucronulate top of the lobes. Filaments subequal, pubescent at their broadened base. Ovary glabrous. Stigmas filiform. *Capsule* 3–4 mm in diam., brown, 8-valved, the valves lanceolate, acute. Seeds 4 or less, 1½–2 mm long, brownish yellow to purplish black, minutely verrucose, glabrous, the angles with a very narrow scarious wing.

Distr. Tropical East Africa, Madagascar and adjacent islands to SE. Asia, tropical Australia, and New Caledonia; throughout *Malaysia* (not yet collected in Borneo).

Ecol. Thickets, secondary forests, teak-forests, grassy places, along-fields, hedges, waysides, often on dry soil, from sea-level to ca 600(—880) m.

Vern. *Aroj djotang lembut*, *araj pondolandak*, *S, kapidatu*, *rawatan*, *lawatan*, *J, siembukan*, *Md, himag*, *P. Bis*.

Notes. The degree of pubescence is markedly variable; the indument of the inflorescences is often denser than that of the other parts. The sepals are slightly unequal in length; the three outer ones, of which the third one is often oblique at the base, are ovate-lanceolate to ovate, acuminate at the apex and attenuate towards the base. In some specimens from E. Java, and the Kangean Islands, the outer sepals are broader than is commonly found; such specimens closely resemble *J. zollingeri*.

A specimen from the island of Salajar (S. of Celebes, TEYSMANN 13885) has an erect habit; it is in the fruiting stage, flowers and leaves are lacking; the younger branches seem to have been densely tomentose. It might represent a distinct variety, as has been supposed already by HALLIER; until more complete material is available a definite opinion is postponed.

*var. tomentosa* (WARB.) OOSTSTR. *comb. nov.*—*Convolvulus multivalvis* R.Br. Prod. (1810) 483 *var. α.*—*Convolvulus parviflorus* VAHL *var. tomentosus* WARB. Bot. Jahrb. 18 (1894) 207.—*J. multivalvis* HALLIER f. Jahrb. Hamb. Wiss. Anst.

(1) According to MERRILL, Sp. Blanc. (1918) 326.

15 (1898) 42.—*J. paniculata* (BURM. f.) HALLIER f. *var. multivalvis* OOSTSTR. *Blumea* 3 (1939) 274.

Much like *var. paniculata* but the whole plant covered with a dense yellowish brown tomentum, finally glabrescent.

Distr. N. Australia and Queensland, in *Malaysia*: Lesser Sunda Islands (Sumba, Timor),



Fig. 19. *Jacquemontia paniculata* (BURM. f.) HALLIER f. *var. paniculata*. Left: flowering specimen; right: fruiting branch,  $\times \frac{1}{3}$ .

E. New Guinea, Philippines (Apo Island in Mindoro Strait).

Ecol. In grass-fields, on rocks, from sea-level to ca 1200 m.

*var. philippinensis* OOSTSTR. *Blumea* 3 (1939) 274.

Differs from *var. paniculata* by the three outer

sepals which are elliptic to elliptic-oblong, obtusish, cuspidate to mucronulate, not distinctly acuminate at the apex, herbaceous; two inner sepals slightly broader, with scarious margins; peduncles filiform and mostly thinner than in *var. paniculata*.

Distr. *Malaysia*: Philippines (Luzon).

Note. This variety varies from short-tomentose to nearly glabrous.

2. *Jacquemontia zollingeri* (CHOISY) HALLIER f. *Bot. Jahrb.* 16 (1893) 543; OOSTSTR. *Blumea* 3 (1939) 275.—*Convolvulus zollingeri* CHOISY in *ZOLL. Syst. Verz.* 2 (1854) 130, 132.

KEY TO THE VARIETIES

- 1. Stems, leaves and inflorescences pubescent to tomentose . . . . . *var. zollingeri*
- 1. Stems and leaves sparsely pilose to glabrescent; inflorescences densely tomentose. *var. jonkeri*

*var. zollingeri*.

A herbaceous twiner, lignescent in the basal parts, pubescent to short-tomentose. Stems terete, glabrescent. *Leaves* ovate,  $3-5\frac{1}{2}$  by  $2-3\frac{1}{2}$  cm, cordate at the base, acute or short-acuminate at the apex, pubescent to short-tomentose; lateral nerves 7-8 on either side of the midrib; petiole  $1-1\frac{1}{2}$  cm. *Peduncles* axillary, rather short, 2-15 mm, pubescent to short-tomentose, cymosely branched, few- to several-flowered. Bracts subulate, the lower to 5 mm long, the upper much shorter. *Sepals* very unequal, the two outer ones broad-ovate, 7 mm long, cordate or rounded at the base, acute to short-acuminate at the apex, herbaceous, pubescent to tomentose; sepal 3 semi-ovate,  $6\frac{1}{2}$  mm long, acute, partly herbaceous, partly scarious, two inner sepals lanceolate,  $4\frac{1}{2}$  mm long, acute, hairy near the apex, for the rest glabrous. *Corolla* funnel-shaped, 9-11 mm long, pale lilac, shallowly 5-lobed, glabrous. Filaments pubescent at their insertion. Stigmas filiform. *Capsule* 8-valved. Seeds 4, ca 2 mm long, black, minutely verrucose, glabrous, the angles with a very narrow scarious wing.

Distr. *Malaysia*: E. Java (Mt Baluran in Besuki), Lesser Sunda Islands (Bali, Sumbawa, Timor).

Ecol. Thickets, from sea-level to ca 30 m.

Note. This species is closely related to *J. paniculata*; it might possibly be better to consider it merely as a variety of that species. Both show a great resemblance in habit as well as in the shape and size of the leaves and inflorescences. The main difference is found in the shape of the sepals. Typical *J. zollingeri* has the same short and dense tomentum as *J. paniculata var. tomentosa*.

*var. jonkeri* OOSTSTR. *Blumea* 3 (1939) 276.

Stems, leaf-blades and petioles sparsely pilose to glabrescent; peduncles, pedicels and sepals densely tomentose. Peduncles 2-5 mm long. Corolla white.

Distr. *Malaysia*: Lesser Sunda Islands (Timor).

3. *Jacquemontia tomentella* (MIQ.) HALLIER f. Versl. 's Lands Pl.-tuin Btzg 1895 (1896) 126; OOSTSTR. Blumea 3 (1939) 276.—*Lettsomia tomentella* MIQ. Fl. Ind. Bat. Suppl. (1861) 560.—Fig. 20.

#### KEY TO THE VARIETIES

1. Sepals 5–6 mm long. Corolla *ca* 15 mm long. Hairs minute, with 7–13 rays. *var. tomentella*
1. Sepals 3–4 mm long. Corolla 8–10 mm long.
2. Hairs of two kinds, for the greater part with 7–13 rays like in *var. tomentella*, the others with 8–10 rays, one of which is much longer and erect *var. heteroradiata*
2. All hairs of the same kind.
3. Hairs with 7–13 rays *var. micrantha*
3. Hairs with 3–4(–5) rays *var. tomentosa*

#### *var. tomentella*.

A large, woody twiner to 12 m high. Stems terete, angular upwards, the younger parts densely puberulent with minute stellate (7–13-rayed) pale yellowish brown hairs, making the impression of being farinose, adult parts glabrescent, fistulose. *Leaves* ovate, 6–14 by 4–10 cm, rounded or slightly cordate at the base, acuminate at the apex, stellately puberulent like the stems, paler beneath than above, glabrescent above; lateral nerves 6–7 on either side of the midrib, prominent beneath; secondary nerves parallel; petiole 2–4½ cm, puberulent like the stems, longitudinally grooved above. *Peduncles* axillary, puberulent like the stems, shorter or longer than the leaves, corymbosely branched above; flowers in dense umbelliform inflorescences, forming large, more or less unilateral panicles at the end of the branches. Pedicels 3–6 mm. Lower bracts sometimes foliaceous, upper ones much smaller. *Sepals* about equal in length, 5–6 mm; two outer ones ovate, obtuse, three inner ones broad-ovate to orbicular, concave, all puberulent outside and with minute glandular dots, glabrous inside. *Corolla* funnel-shaped, 14–15 mm long or more, pink or white, with 5 densely pilose midpetaline bands. Filaments with dilated, pilose base. Ovary pilose; style pilose near the base; stigmatic lobes thick, nearly globular, wrinkled. Capsule unknown.

Distr. *Malaysia*: Sumatra (W. Coast, Djambi), W. Borneo.

Vern. *Akar kumiet*, Sum. W. Coast, *lehu-lehu*, Djambi.

Note. All parts of the plant are covered with a dense pubescence consisting of very small scale-like stellate hairs, with 7–13 short rays.

*var. micrantha* HALLIER f. Bot. Jahrb. 49 (1913) 377; OOSTSTR. Blumea 3 (1939) 277.—Fig. 20.

Stellate hairs similar to those in *var. tomentella*, but of a more silvery greyish colour. Flowers smaller. Sepals 3–4 mm long. Corolla 8–10 mm long, red-purple, rose-pink, or white. Capsule ovoid, mucronate, *ca* 8 mm high, brown; valves 4, lanceolate, acute, hairy at the top. Seeds 4, or often less, brownish black, glabrous.

Distr. *Malaysia*: Sumatra (E. Coast), Borneo. Ecol. Edges of secondary forests; forming dense masses over exposed low undergrowth; below 300 m.

Vern. *Akar guluan*, Sum. E. Coast, *ampur*, W. Borneo, *djelaang*, SE. Borneo, *pangubao*, Br. N. Borneo.

*var. heteroradiata* OOSTSTR. Blumea 3 (1939) 277.

Like *var. micrantha*, but the stellate hairs of two kinds, for the greater part as in *var. micrantha*, otherwise with 8–10 rays, one of which is much longer and erect.

Distr. *Malaysia*: SE. Borneo.



Fig. 20. *Jacquemontia tomentella* (MIQ.) HALLIER f. *var. micrantha* HALLIER f. Flowering branch,  $\times 1/3$ .

*var. tomentosa* OOSTSTR. Blumea 3 (1939) 278.

Like *var. micrantha*, but the stellate hairs with 3–4, occasionally with 5 rays; rays longer than in *var. micrantha*; hairs often differing in size, often larger ones mixed with smaller. The indument on the lower surface of the leaves is often much denser than on the upper surface; sometimes the upper surface is nearly glabrous.

Distr. *Malaysia*: Borneo (Sarawak).

4. *Jacquemontia browniana* OOSTSTR. *nom. nov.*—*Ipomoea erecta* R. BR. Prod. (1810) 487; BTH. Fl. Austr. 4 (1869) 427; F.v.M. Descr. Notes Pap. Pl. 6 (1885) 15; BAILEY, Queensl. Fl. 4 (1901) 1067; *non J. erecta* CHOISY, 1845.

Stems erect or ascending, simple or slightly branched, softly tomentose or villose, with rust-coloured hairs, as well as the foliage and inflorescences. *Leaves* oblong or lanceolate,  $2\frac{1}{2}$ –5 by  $1\frac{1}{2}$ –1 cm, or the upper ones smaller, narrowed at the base, obtuse or acute at the apex; petiole very short. *Peduncles* mostly shorter than the leaves, 1–3-flowered. Pedicels short, 1–4 mm. Bracts minute, subulate. Outer *sepals* ovate-lanceolate, ca 7–10 mm long, rather acute, softly villose or nearly glabrous; inner ones a little shorter. *Corolla* campanulate, ca 2 cm long, pink. Stigmatic lobes broadly ovate, recurved. *Capsule* 6–8-valved. Seeds glabrous. (Description partly after BROWN, BENTHAM and BAILEY, *ll.cc.*)

Distr. N. Australia, Queensland, Jervis Island (Torres Straits), not yet found in New Guinea proper.

**5. *Jacquemontia pentantha* (JACQ.) G. DON**, Gen. Syst. 4 (1838) 283; OOSTSTR. *Blumea* 3 (1939) 278. —*Convolvulus pentanthus* JACQ. Coll. 4 (1790) 210.

A glabrous or sparsely hairy twiner. *Leaves* ovate to broad-ovate,  $2\frac{1}{2}$ –9 by 2–7 cm, cordate to truncate at the base, acuminate at the apex; petiole  $1\frac{1}{2}$ –4 cm. *Peduncles* long and slender. *Flowers* in a few- to many-flowered umbelliform cyme. Bracts much longer than in *J. paniculata*,

linear, lower ones 5–10 mm. Two outer *sepals* ovate, 7–10 mm long, long-acuminate; third sepal oblique, semi-ovate; two inner *sepals* much shorter, ovate to lanceolate, acuminate. *Corolla* blue or blue-purple, white at the base, rarely entirely white, mostly larger than in *J. paniculata*,  $1\frac{1}{2}$ –2 cm long, limb ca 2 cm broad. Stigmas elliptic.

Distr. Subtropical and tropical America; elsewhere, incl. *Malaysia*, cultivated in the tropics as an ornamental.

**6. *Jacquemontia blanchetii* MORIC.** Pl. Nouv. Am. (1833–46) 41, t. 27; OOSTSTR. *Blumea* 3 (1939) 278.

A glabrous or sparsely hairy twiner, adult stems lignescent,  $1\frac{1}{2}$ –3 m. *Leaves* ovate or ovate-oblong, 4–8 by 2–4 cm, cordate at the base, acuminate at the apex; petiole 1–3 cm. *Peduncles* long and slender, 5–10 cm. *Flowers* in 3–12-flowered umbelliform cymes. Bracts minute. *Sepals* glabrous; two outer ones ovate to elliptic, 4–6 mm long, obtuse; three inner ones longer, more oblong, 5–7½ mm long, obtuse. *Corolla* blue or violet, the midpetaline bands paler outside, ca  $2\frac{1}{2}$ –3 cm long. Stigmas broadly elliptic to orbicular.

Distr. Tropical S. America, in *Malaysia* cultivated as an ornamental.

Note. Sometimes cultivated under the erroneous name *J. martii* CHOISY.

## 9. ANISEIA

CHOISY, Mém. Soc. Phys. Genève 6 (1833) 481; 8 (1838) 65; OOSTSTR. *Blumea* 3 (1939) 279.—*Ipomoea* subg. *Aniseia* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 200.—*Ipomoea* § *Aniseia* GAGNEP. & COURCH. in Fl. Gén. Indo-Chine 4 (1915) 231.—**Fig. 21.**

Prostrate or twining herbs. *Leaves* petioled, linear, oblong, lanceolate, ovate or elliptic, often mucronulate. *Flowers* on axillary peduncles, in one- to few-flowered cymes. *Sepals* 5, herbaceous, acute or acuminate, unequal, the 3 outer ones much larger than the inner, often decurrent on the pedicel, enlarged in fruit. *Corolla* regular, broadly tubular to funnel-shaped, with 5 well-limited hairy midpetaline bands outside, limb 5-toothed or nearly entire. *Stamens* and style included. *Stamens* 5, filaments adnate to the corolla, filiform; pollen smooth. Disk small or absent. *Ovary* glabrous, 2-celled, each cell with 2 ovules; style 1, simple, filiform; stigmas 2, thick, globular or oblong. *Capsule* ovoid or globose, glabrous, 2-celled, 4-valved. Seeds 4 or less, trigonous or globose, black.

Distr. A small genus of at most ca 5 spp. confined to tropical and subtropical America with the exception of one, which also occurs in the tropics of the Old World.

**1. *Aniseia martinicensis* (JACQ.) CHOISY**, Mém. Soc. Phys. Genève 8 (1838) 66; OOSTSTR. *Blumea* 3 (1939) 279.—*Convolvulus martinicensis* JACQ. Sel. Stirp. Amer. f. (1763) 26, t. 17.—*Convolvulus uniflora* BURM. f. Fl. Ind. (1768) 47, t. 21, f. 2.—? *Convolvulus emarginatus* VAHL, Symb. Bot. 3 (1794) 23.—*Ipomoea uniflora* R. & SCH. Syst.

4 (1819) 247.—*A. uniflora* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 483, t. 2, f. 9.—*A. emarginata* HASSK. Cat. Hort. Bogor. (1844) 139.—**Fig. 21.**

Stems herbaceous, twining or prostrate, rooting in the basal parts (always?), to  $1\frac{1}{2}$  m long, terete, finely striate or smooth, appressed-pilose or gla-

brous. *Leaves* narrowly to broadly oblong  $3\frac{1}{2}$ –7 (–11) by  $\frac{3}{4}$ –3 (–5) cm, attenuate towards the base, obtuse, truncate or emarginate, and mucronulate at the apex, rarely acute, glabrous or sparsely pilose above, sparsely pilose or rarely glabrous beneath; petiole short,  $\frac{1}{2}$ –2 cm. *Peduncles* 1- or sometimes 2–3-flowered, shorter than the leaves, 2–5 cm long, more or less densely pilose, often denser towards the top. *Pedicels* shorter than the outer sepals, 5–7 mm or slightly longer, appressed-pilose. *Bracts* small, narrow-lanceolate to subulate, acute. *Sepals* reticulately veined, the 3 outer ones 12–20 mm long, sparsely pilose outside; sepal 1 & 2 ovate, acute and mucronulate at the apex, rounded, slightly cordate or acute at the base, and shortly decurrent on the pedicel; sepal 3 lanceolate, more or less falcate, shortly decurrent; two inner sepals 10–13 mm long, ovate to lanceolate, acute or acuminate at the apex, not decurrent at the base; outer sepals enlarged in fruit, scarious, 2–2½ cm long. *Corolla* funnel-shaped, 2–3 cm long, white; limb shallowly 5-lobed; midpetaline bands hairy, with a hairy mucro; connecting fields glabrous. *Filaments* hairy at the base. *Capsule* ovoid, valves oblong, acute, brown outside, silvery white and shining inside. *Seeds* 4 or less, 5–6 mm diam., minutely pilose on the sides, woolly at the edges.

*Distr.* Pantropic, throughout *Malaysia*: not yet known from the Lesser Sunda Islands.

*Ecol.* In marshy grasslands, freshwater swamps, marshy thickets, along river-banks, edges of pools, at low altitudes.

*Use.* Used as a vegetable in the Malay Peninsula and in Borneo.

*Vern.* *Akar ulan putih*, *akar lidah patong*, Mal. Pen., *bagiu serut*, Djambi, *karut*, Palembang, *hat bijawak*, W. Kutai, *m(w)anaring-i-lawanan*, *wanaring pante*, Manado, *imerpur*, *dro*, Neth. N. Guinea.



Fig. 21. *Aniseia martinicensis* (JACQ.) CHOISY. Left: flowering branch; right: fruiting branch,  $\times \frac{1}{3}$ .

## 10. CONVULVULUS

LINNÉ, *Sp. Pl.* (1753) 153; *Gen. Pl.* ed. 5 (1754) 76; OOSTSTR. *Blumea* 3 (1939) 282.

Annual or perennial, prostrate, erect or twining herbs, or erect undershrubs or shrubs; hairs simple or rarely with 2 arms. *Leaves* entire, or rarely more or less deeply lobed, often spatulate and attenuate into the petiole, or more or less hastate or sagittate at the base. *Flowers* on axillary peduncles, in one- to few-flowered cymes or in dense involucrate heads. *Sepals* 5, equal or subequal, obtuse or acute. *Corolla* regular, medium-sized or small, campanulate or funnel-shaped, white, pink, blue or yellow, with 5 often not well-defined midpetaline bands; limb shallowly lobed or subentire. *Stamens* and style included. *Stamens* 5; filaments adnate to the corolla, often unequal, filiform; pollen smooth, ellipsoid. *Disk* annular or cup-shaped. *Ovary* 2-celled, each cell with 2 ovules; style 1, simple, filiform; stigmas 2, filiform. *Capsule* 2-celled, usually 4-valved. *Seeds* 4 or less, often verruculose, mostly glabrous, black or brown.

*Distr.* A large genus of ca 250 *sp.* or more, in the temperate and subtropical regions of both hemispheres, rarer in the tropics; one species in *Malaysia*.

1. *Convolvulus arvensis* LINNÉ, Sp. Pl. (1753) 153; OOSTSTR. *Blumea* 3 (1939) 283.

A perennial herb. Stems prostrate or twining, glabrous or sparsely pubescent. *Leaves* ovate-oblong to lanceolate,  $1\frac{1}{2}$ -5 by 1-3 cm, mostly hastate or sagittate at the base, obtuse and mucronulate at the apex, often more or less secund; petiole shorter than the blade. *Peduncles* axillary, 1- or sometimes 2-3- to more-flowered, shorter to longer than the leaves. Pedicels much longer than the calyx. Bracts linear, ca 3 mm long. *Sepals*  $3\frac{1}{2}$ -5 mm long, slightly unequal, 2 outer ones a little shorter, oblong-elliptic, obtuse, shortly ciliate; inner ones nearly orbicular, obtuse or slightly retuse, more or less distinctly mucronulate. *Corolla* broadly funnel-shaped, ca 2 cm long, white or pink, or white with pink or red midpetaline bands, or pink with red or white midpetaline bands. Stamens slightly unequal, filaments with a broadened base, papillose at the margins. Ovary glabrous. *Capsule* ovoid-globose, 5-8 mm long,

glabrous. Seeds 4, dark brown or black, 3-4 mm long.

Distr. Widely distributed in the temperate parts of both hemispheres, rarely in the subtropics and the tropics, in *Malaysia*: local on Mt Tengger-Smeru (1927) at 2100 m, apparently introduced.

Ecol. In waste places, cultivated land, along roadsides and railways.

Vern. *Bindweed*, E, *akkerwinde*, D.

#### Excluded

*Convolvulus sphaerostigma* CAV. Icon. 5 (1799) 54, t. 481 (= *Jacquemontia hirsuta* CHOISY) has been mentioned by CAVANILLES from Mindanao and from Mexico. According to MERRILL (Philip. J. Sc. 10, 1915, Bot. 193; En. Philip. 3, 1923, 359) the Mindanao record was based either on an erroneously localized specimen (Malaspina Expedition), or on an erroneously identified one.

### 11. CALYSTEGIA

R.BR. Prod. (1810) 483, *nom. cons.*; OOSTSTR. *Blumea* 3 (1939) 284.—*Convolvulus* sect. *Calystegia* BTH. Fl. Austr. 4 (1869) 428, 430.

Prostrate or twining, perennial herbs. *Leaves* petioled, mostly glabrous, often sagittate to hastate, with rounded, angular or lobed basal lobes. *Flowers* on axillary, peduncled, one- or rarely few-flowered cymes. Bracts 2, mostly large, ovate or elliptic, embracing the calyx, persistent. *Sepals* 5, subequal, ovate to oblong, acute or obtuse, herbaceous. *Corolla* regular, medium-sized or large, glabrous, campanulate to funnel-shaped, white or pink (rarely yellowish), outside with 5 distinct midpetaline bands; limb shallowly lobed or subentire. *Stamens* and style included. Stamens 5, adnate to the corolla-tube; filaments subequal; pollen globular, smooth. Disk annular. *Ovary* 1-celled or imperfectly 2-celled, 4-ovuled; style 1, simple, filiform; stigmas 2, mostly oblong or elliptic, complanate. *Capsule* ovoid or globose, 4-valved. Seeds 4, smooth or verrucose, black.

Distr. *Ca* 25 spp. in the warm and temperate regions of both hemispheres; one species in *Malaysia*, possibly only as a casual weed.

1. *Calystegia hederacea* WALL. in ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 94; OOSTSTR. *Blumea* 3 (1939) 285.—*Convolvulus wallichianus* SPRENG. Syst. 4, 2 (1827) 61.

Probably a perennial herb. Stems slender, prostrate or twining, glabrous. *Leaves* glabrous, oblong to triangular,  $1\frac{1}{2}$ -4(- $7\frac{1}{2}$ ) by  $\frac{1}{2}$ -2(- $2\frac{1}{2}$ ) cm, the base cordate or sagittate, the basal lobes rounded and entire, or angular to 2-lobed; the apex obtuse or slightly emarginate; petiole shorter than or nearly as long as the blade. *Peduncles* axillary, 1-flowered, 2-5 cm long. Bracts elliptic, 6-8 mm long, obtuse. *Sepals* oblong, obtuse, mucronulate, glabrous, the outer ones ca 6(- $7\frac{1}{2}$ ) mm long, the inner ones somewhat shorter. *Corolla* campanulate, ca 2 cm long, pinkish purple, limb subentire. Filaments dilated at the base. Ovary

glabrous; stigmas elongate. *Capsule* ovoid, subacute, ca  $7\frac{1}{2}$  mm long, glabrous. Seeds glabrous.

Distr. Abyssinia, S. Asia (from Punjab and Afghanistan to N. and E. Bengal) and E. Asia (China, Amurland, and Japan), in *Malaysia*: Malay Peninsula (Penang), once collected, acc. to PRAIN possibly only a casual weed.

#### Excluded

*Calystegia sepium* (L.) R.BR. Prod. (1810) 483; OOSTSTR. *Blumea* 3 (1939) 285.—*Convolvulus sepium* LINNÉ, Sp. Pl. (1753) 153.

This species, mentioned by MIQUEL, BOERLAGE, and KOORDERS for Java, does not occur in *Malaysia*.

## 12. HEWITTIA

WIGHT & ARNOTT, *Madr. J. Sc. I*, 5 (1837) 22.—*Shuterea* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 485, t. 2, f. 11; OOSTSTR. *Blumea* 3 (1939) 286; *non Shuteria* WIGHT & ARNOTT, 1834, *nom. cons. Legum.*—Fig. 22.

A twining or prostrate pubescent herb. *Leaves* petioled, entire, angular or lobed, usually cordate at the base. *Flowers* on axillary peduncles, in one- to few-flowered cymes. Bracts 2, oblong or linear-lanceolate, acuminate, inserted at some distance of the calyx. *Sepals* 5, usually acute, herbaceous; the 3 outer ones large, ovate, accrescent in fruit; the 2 inner ones much smaller. *Corolla* regular, medium-sized, campanulate to funnel-shaped; limb shallowly 5-lobed. *Stamens* and style included; filaments adnate to the corolla-tube, filiform with a dilated base; pollen smooth. Disk annular. *Ovary* hairy, 1-celled, or imperfectly 2-celled at the top, 4-ovuled; style 1, simple, filiform; stigmas 2, ovate-oblong, complanate. *Capsule* 1-celled, more or less distinctly 4-valved. Seeds 4 or less, dull black.

Distr. Monotypic, distributed through the tropics of the Old World, throughout *Malaysia* to *Polynesia*.

1. *Hewittia sublobata* (L. f.) O.K. *Rev. Gen. Pl.* (1891) 441.—*Convolvulus sublobatus* LINNÉ f. *Suppl.* (1781) 135.—*Convolvulus bracteatus* VAHL, *Symb. Bot.* 3 (1794) 25.—*Convolvulus bicolor* VAHL, *l.c.* 25.—*Ipomoea bracteata* R. & SCH. *Syst.* 4 (1819) 227.—*Ipomoea malabarica* (non R. & SCH.) BL. *Bijdr.* (1825) 715.—*Shuterea bicolor* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 486, t. 2, f. 11.—*Convolvulus hederaceus* BLANCO, *Fl. Filip.* ed. 1 (1837) 90.—*H. bicolor* WIGHT & ARNOTT, *Madr. J. Sc. I*, 5 (1837) 22.—*Aniseia bracteata* HASSK. *Pl. Jav. Rar.* (1848) 516.—*Argyreia cymosa* (non SWEET) CLARKE in *HOOK. f. Fl. Br. Ind.* 4 (1883) 190, *quoad specim. Philip.*—*Shuterea sublobata* HOUSE, *Bull. Torr. Bot. Club* 33 (1906) 318; OOSTSTR. *Blumea* 3 (1939) 287.—Fig. 22.

Stems herbaceous, slender, 1–2 m long, prostrate or twining, more or less densely pubescent, glabrescent, angular, occasionally rooting. *Leaves* ovate to broad-ovate, 3–12 by 4–10 cm, cordate or sometimes truncate at the base, the basal lobes entire or angular, sometimes spreading and then the blade more or less hastate; apex acuminate, acute or obtuse, mucronulate; leaf-surfaces appressed-pilose with short hairs, especially beneath, or nearly glabrous; petiole 1–6 cm long, pubescent. *Peduncles* shorter to longer than the petioles, 1–10 cm, pubescent, upwards often more densely so. *Pedicels* very short, up to 3, in fruit up to 5 mm long. Bracts oblong-lanceolate or narrower,  $1\frac{1}{2}$ – $1\frac{1}{2}$  cm long. *Sepals* more or less hairy outside and along their margins, unequal, the three outer ones much larger than the inner, broadly to narrowly ovate, 9–15, afterwards to 17 mm long, acute or obtusish; sepal 3 more or less oblique; two inner sepals ovate with a broadened and scariously margined base, 7– $7\frac{1}{2}$  mm long; nerves of sepals prominent in fruiting stage. *Corolla* pale yellow or white, mostly with a purple centre, 2– $2\frac{1}{2}$  cm long, with 5 pilose midpetaline bands; limb with very short, rounded, emarginate, mucronulate lobes. Filaments with a minutely papillose

base. *Capsule* depressed-globose to more or less quadrangular, mucronate, ca 8 by ca 10 mm, patently pilose. Seeds 2–4, glabrous, except the pubescent hilum, 5–6 mm long.

Distr. Tropical Africa (S. to Natal), tropical

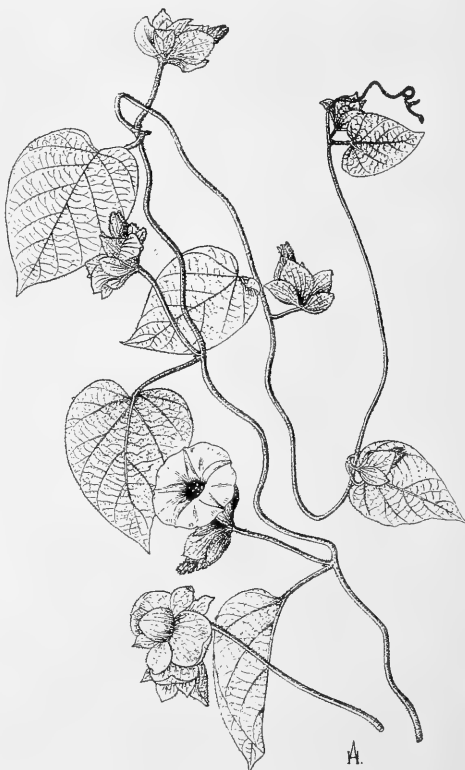


Fig. 22. *Hewittia sublobata* (L. f.) O.K. Flowering specimen and fruiting peduncle,  $\times \frac{1}{3}$ .

Asia (India, Ceylon, Indo-China, N. to China), Polynesia, throughout *Malaysia*.

Ecol. Open grasslands, thickets, hedges, teak-forests, grassy dikes and waysides, waste places, at low and medium altitudes, both in regions with

a feeble and with a pronounced dry season, from sea-level to 1400 m.

Vern. *Kamet, sembanjan, lawatan, J, uwi malojo*, Manado; Philippines: *banaiyan, palupasagig*, P. Bis., *dinukdukto*, Ig., *panggipanggi*, Sulu.

13. MERREMIA

DENNSTEDT, (Schlüss. Hort. Malab. 1818, 34, *emend.* HALLIER f. Bot. Jahrb. 16 (1893) 581; OOSTSTR. *Blumea* 3 (1939) 292.—*Skinneria* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 487, t. 6, *non Skinnera* FORST. 1776.—*Spiranthera* BOJ. Hort. Maurit. (1837) 226, *p.p.*, *non* ST. HIL., 1823.—Fig. 23-31.

Herbs or shrubs, usually twining, but also prostrate or erect herbs or low erect shrubs. *Leaves* mostly petioled, variable in shape and size, entire, dentate, lobed or palmately or pedately partite or compound (rarely very small and subulate). *Flowers* axillary, solitary, or in axillary few- to many-flowered variously ramified inflorescences, large, medium-sized or small. Bracts usually small. *Sepals* 5, usually subequal, elliptic to lanceolate, acute or acuminate, or ovate to orbicular, obtuse or emarginate, concave, in several *spp.* enlarged in fruit. *Corolla* regular, funnel-shaped or campanulate, mostly glabrous, white, or yellow to orange, mostly with 5 distinctly nerved midpetaline bands; limb slightly 5-lobed. *Stamens* 5, included; anthers often contorted; filaments filiform, often broadened at the base, often unequal; pollen smooth. *Ovary* 2- or 4-celled, rarely incompletely 2-celled, 4-ovuled; style 1, simple, filiform, included; stigma 2-globular. Disk often annular. *Capsule* generally 4-valved or more or less irregularly dehiscent; 4-1-celled. *Seeds* 4, or less by abortion, glabrous, pubescent or villose, especially at the margins.

Distr. *Ca* 80 *spp.*. Widely spread in the tropical countries of both hemispheres.

Use. Several species are used in native medicine.

KEY TO THE SPECIES

- 1. Leaves palmately 5-7-lobed to palmately compound, with 5 leaflets.
  - 2. Peduncles glandular in the upper part, the glands sometimes mixed with patent bristly hairs. Sepals narrow-ovate to oblong, obtuse, to 8 mm long. Corolla 2½-3½ cm long or less, pale yellow, or whitish. Leaves palmately compound, with 5 leaflets . . . . . 7. *M. quinquefolia*
  - 2. Peduncles glabrous or hairy, not glandular.
- 3. Leaves palmately compound; leaflets 5, entire.
  - 4. Outer sepals glabrous, 7½-8½ mm long, ovate to ovate-oblong, obtuse. Corolla to 5 cm long. 8. *M. quinata*
  - 4. Outer sepals patently hirsute, 15-25 mm long, ovate-lanceolate, acute or acuminate. Corolla 2½-3½ cm long 10. *M. aegyptia*
- 3. Leaves palmately 5-7-lobed or sometimes divided nearly to the base, not palmately compound.
  - 5. Plant entirely glabrous. Leaves palmately divided to far below the middle, with 7 entire, oblong-lanceolate segments. Outer sepals ovate to broad-ovate, obtuse, 23-25 mm long. Corolla ca 5½ cm long, yellow . . . . . 9. *M. tuberosa*
  - 5. Plant hairy. Leaf-segments mostly dentate, crenate, or lobed.
    - 6. Leaves palmately divided nearly to the base; segments 5-7, lanceolate, coarsely dentate to irregularly pinnately lobed. Peduncles patently hirsute, pedicels and sepals glabrous. Sepals ovate-lanceolate, acute, 20-25 mm long. Corolla 3-3½ cm long, white with a rose-purple throat. 11. *M. dissecta*
    - 6. Leaves palmately 5-7-lobed; lobes broadly triangular to lanceolate, coarsely dentate to crenate, or subentire. Peduncles, pedicels and outer sepals patently hirsute. Sepals oblong or ovate-oblong, obtuse or acutish, 12-20 mm long. Corolla 4-6 cm long, yellow . . . . . 12. *M. vitifolia*
- 1. Leaves entire, crenate, or at most 3-lobed.
  - 7. Pedicels with a thick, lobed ring immediately below the calyx. Sepals obovate to broadly elliptic or



- orbicular, obtuse or retuse, to 15–18 mm long. Corolla *ca* 4 cm long . . . . . 23. *M. similis*
7. Pedicels without a thick, lobed ring at the apex.
8. Leaves peltate (occasionally with exception of the leaves of the inflorescences).
9. Sepals (15–)18–25 mm long. Corolla 4½–6 cm long, yellow or white . . . . . 21. *M. peltata*
9. Sepals less than 15 mm long. Corolla 3–3½ cm long, white . . . . . 22. *M. elmeri*
8. Leaves not peltate.
10. Midpetaline bands of the corolla pilose outside, or only at their top.
11. Corolla pilose at the upper portion of the midpetaline bands, 2–3½ cm long, white, or yellow to orange. Sepals broad-elliptic to orbicular, rounded to emarginate, 5–8 mm long.
13. *M. umbellata*
11. Midpetaline bands of the corolla densely sericeous outside. Corolla *ca* 2 cm long, white or yellow. Outer sepals orbicular to transverse-elliptic, broadly rounded to emarginate, 5–7 mm long, inner ones transverse-elliptic . . . . . 14. *M. boisiana*
10. Corolla entirely glabrous outside, sometimes with minute glands.
12. Peduncle very short or nearly absent. Flowers in axillary clusters or solitary in the leaf-axils. Pedicels short, 2–4 mm; sepals hairy on the back and fimbriate along the margins. Corolla 10 mm long, or less. Leaves kidney-shaped to broadly ovate. Prostrate herb.
5. *M. emarginata*
12. Peduncles longer.
13. Sepals 10 mm long or mostly shorter.
14. At least the inner sepals acute, attenuate-acuminate into a slender point. 6. *M. tridentata*
14. Sepals obtuse.
15. Twining or prostrate herbs, rarely woody plants. Midpetaline bands with distinct dark lines, at least in the dried state.
16. Sepals slightly unequal in length; outer ones broadly obovate to orbicular, or broadly spatulate, distinctly concave.
17. Outer sepals mostly hairy, 4–7 mm long, broadly obovate to orbicular, emarginate, not or slightly mucronulate; inner ones 6–8 mm. Corolla 1½–2 cm long (in *var. splendens* 3–3½ cm), yellow. Capsule depressed-globose, valves coarsely wrinkled. Petiole generally without tubercles . . . . . 1. *M. gemella*
17. Outer sepals generally glabrous, 3½–4 mm long, broadly obovate to spatulate, broadly notched at the apex and distinctly mucronulate; mucro directed outwards; inner sepals to 5 mm long. Corolla *ca* 1 cm or less, yellow. Capsule depressed-globose or broadly conical, slightly 4-angular, less coarsely wrinkled. Petiole often with small tubercles.
2. *M. hederacea*
16. Sepals unequal in length; outer ones shorter, elliptic to oblong-elliptic or oblong, less concave or flat.
18. Outer sepals elliptic, 3–4 mm long, inner ones oblong or elliptic, 4½–6 mm long. Peduncles filiform. Bracts minute, 1–2 mm. Leaves variable, linear to oblong or ovate, rounded, truncate, cordate or hastate at the base. Capsule broadly ovoid to globular, smooth.
3. *M. hirta*
18. Outer sepals oblong or oblong-elliptic, 4 mm long, inner ones broadly ovate to orbicular, 6 mm long. Peduncles thicker. Bracts larger, to 4 mm long. Leaves ovate, cordate at the base. Capsule subglobular, valves reticulately wrinkled . . . . . 4. *M. dichotoma*
15. Larger woody twiners. Midpetaline bands without distinct dark lines.
19. Two outer sepals broadly oblong, *ca* 7 mm long, three inner ones broadly elliptic to orbicular, 8–9 mm long. Corolla 1½ cm long, yellow (or sometimes white?). Nerves 5–6 on either side of the midrib . . . . . 19. *M. clemensiana*
19. Sepals broadly elliptic to orbicular, outer ones 9–10 mm long. Corolla 2–2½ cm long, yellow. Nerves 7–10 on either side of the midrib . . . . . 20. *M. korthalsiana*
13. Sepals longer than 10 mm.
20. Sepals at most 12 mm long, outer ones broadly elliptic, inner ones broadly elliptic to orbicular. Corolla *ca* 2½ cm long. Flower-buds conical, acute. Leaves ovate, cordate at the base; nerves very prominent beneath. Woody twiner; stems lenticellate.
18. *M. crassinervia*
20. Sepals longer, 15 mm or more. Corolla 5 cm long or more.
21. Corolla 7–8 cm long, white. Sepals *ca* 25–30 mm long, the outer ones broadly ovate to broadly elliptic, inner ones narrower. Stems smooth . . . . . 15. *M. mammosa*
21. Corolla smaller, *ca* 5½–6 cm long, yellow.
22. Leaves orbicular to broadly ovate, with (6–)8–11 nerves on either side of the midrib, more or less bullate. Sepals elliptic to broadly elliptic, 15–22 mm long. Stems woody, distinctly lenticellate . . . . . 16. *M. borneensis*
22. Leaves ovate, with 6–7 nerves on either side of the midrib, not bullate. Sepals oblong or elliptic-oblong, 25–28 or the inner ones to 30 mm long. Stems woody, sparsely lenticellate.
17. *M. pulchra*

## 1. Section Eu-Merremia

OOSTSTR. Blumea 3 (1939) 297.—*Skinneria* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 487, t. 6, non *Skinnera* FORST. 1776.—*Merremia* sect. *Skinneria* (CHOISY) HALLIER f. Bot. Jahrb. 16 (1893) 552.

Flower-buds oblong, ovoid or globular, obtuse; midpetaline bands in the dried state with 5 dark lines; flowers rather small or small.

1. *Merremia gemella* (BURM. f.) HALLIER f. Bot. Jahrb. 16 (1893) 552; OOSTSTR. Blumea 3 (1939) 297, f. 1, g-h.—*Convolvulus gemellus* BURM. f. Fl. Ind. (1768) 46, t. 21, f. 1.—*Ipomoea gemella* ROTH, Nov. Pl. Sp. (1821) 110.—*Ipomoea radicans* BL. Bijdr. (1825) 712, non BERT. ex CHOISY, 1845.—*Ipomoea polyantha* MIQ. Fl. Ind. Bat. 2 (1857) 613, non *Convolvulus polyanthus* WALL., 1828.—*Ipomoea cymosa* R. & SCH. var. *radicans* MIQ. Fl. Ind. Bat. 2 (1857) 613.—Fig. 23c.

## KEY TO THE VARIETIES

1. Corolla  $1\frac{1}{2}$ –2 cm long . . . . var. **gemella**  
1. Corolla 3– $3\frac{1}{2}$  cm long . . . . var. **splendens**

var. **gemella**.

A twining or prostrate herb. Stems slender, to 3 m long, with rather long, curled, more or less appressed to patent hairs, especially at the nodes, afterwards glabrescent, sometimes already glabrous in youth; prostrate stems often rooting both

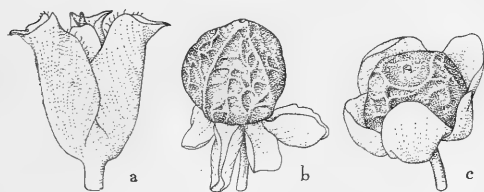


Fig. 23. a-b. *Merremia hederacea* (BURM. f.) HALLIER f. a. calyx,  $\times 5$ , b. capsule,  $\times 2\frac{1}{2}$ .—c. *Merremia gemella* (BURM. f.) HALLIER f., capsule,  $\times 2$ .

at the nodes and internodes. Leaves usually ovate or broad-ovate, rarely narrow-ovate to oblong in outline, more rarely nearly kidney-shaped,  $2\frac{1}{2}$ –12 by  $1\frac{1}{2}$ –10 cm, broadly cordate or rarely more or less sagittate at the base, acuminate or gradually attenuate at the apex, with obtuse or acute, sometimes slightly retuse, mucronulate top; in the kidney-shaped leaves with a broadly rounded apex; leaf-margin entire or coarsely crenate to dentate, sometimes 3-lobed; surfaces glabrous or pilose on the nerves beneath or occasionally on both sides, or pilose on both sides over the whole surface; petiole shorter than or as long as the blade,  $1\frac{1}{2}$ –6(–10) cm, appressed-pilose, rarely minutely tuberculate. Peduncles axillary, with short curled hairs, or glabrous,  $2\frac{1}{2}$ –10(–16) cm, cymosely branched at the apex. Pedicels 3–6 mm

long, appressed-pilose. Bracts minute, caducous. Flower-buds ovoid to globose, obtuse. Sepals thinly coriaceous with scarious margin, slightly unequal, concave, broadly obovate to orbicular, emarginate and mostly mucronulate at the apex, outer ones 4–7 mm, inner ones 6–8 mm long (in poorly developed specimens sometimes only ca 4 mm), outer more or less pilose or sometimes glabrous, inner glabrous or nearly so, all slightly enlarged in fruit. Corolla campanulate to funnel-shaped,  $1\frac{1}{2}$ –2 cm long, glabrous, yellow; limb slightly 5-lobed, lobes shallowly emarginate and mucronulate. Filaments hairy at the base. Ovary glabrous. Capsule depressed-globose, coarsely wrinkled in dry specimens, glabrous, ca 7 mm high, 2-celled. Seeds 4–1, dark grey or brownish puberulent, trigonous, or globose when only one seed has been developed.

Distr. SE. Asia to tropical Australia, throughout Malaysia.

Ecol. In thickets, on hedges, in grasslands, in teak-forests, along railroads, on dikes of rice-fields, often on moist soil, from sea-level to 250 m.

Vern. *Lawattan, tatapajan, S, lawatan, rawatan, lawatan kuning, sampar kidang, indjèn indjèn, J, keritang tikus, Kutai, beloka, djonge djonge, wale-in-sengit, amut peror, Celebes, Philippines: bangbaigau, marakamôte, Il., kamokamotihan, Pang., talanuk, Tag.*

var. **splendens** OOSTSTR. Blumea 3 (1939) 302.

Corolla longer than in the typical form, to 3– $3\frac{1}{2}$  cm long.

Distr. Malaysia: SE. New Guinea (Lake Dairumbu on the Middle Fly River).

Ecol. River-banks, lake-shores, reed-swamps, on grass and borders of undergrowth of rain-forest.

2. *Merremia hederacea* (BURM. f.) HALLIER f. Bot. Jahrb. 18 (1894) 118; OOSTSTR. Blumea 3 (1939) 302, f. 1, e-f, m-n.—*Evolvulus hederaceus* BURM. f. Fl. Ind. (1768) 77, t. 30, f. 2.—*Convolvulus acetosellaefolius* DESR. in LAMK, Enc. 3 (1789) 564.—*Convolvulus dentatus* VAHL, Symb. Bot. 3 (1794) 25.—*M. convolvulacea* DENNST. (Schlüss. Hort. Malab. 1818, 12, 23, 34, nom. nud.) ex HALLIER f. Bot. Jahrb. 16 (1893) 552.—*Ipomoea chryseides* KER-GAWL. Bot. Reg. (1818) t. 270.—*Lepistemon muricatum* SPANOGHE, Linnaea 15 (1841) 339.—*Ipomoea acetosellaefolia* CHOISY in DC. Prod. 9 (1845) 383.—*Ipomoea subtriflora* ZOLL. & MOR. in MOR. Syst. Verz. (1846) 51.—*M. chryseides* HALLIER f. Bot. Jahrb. 16 (1893) 552.—Fig. 23 a-b; 24c-d.

A twining or prostrate herb; the prostrate specimens rooting at the nodes or sometimes at the internodes. Stems slender, smooth or minutely tuberculate, glabrous or sparsely hirsute, especially at and above the nodes. *Leaves* ovate in outline,  $1\frac{1}{2}$ –5 by  $1\frac{1}{4}$ –4 cm, broadly cordate at the base, mostly obtuse and mucronulate at the apex; margin entire or crenate to shallowly or deeply 3-lobed; surfaces glabrous or sparsely hairy; petiole slender,  $\frac{1}{2}$ –6 cm, with a few small tubercles, especially in the basal half. *Peduncles* thicker than the petioles, shorter than or exceeding the leaves, 1–10 cm, mostly glabrous, smooth or occasionally minutely tuberculate. *Flowers* one or few to several,

transversely or reticulately wrinkled, less coarsely than in *M. gemella*. Seeds mostly 4, short-pubescent or nearly glabrous over the whole surface, or with longer hairs at the hilum and along the edges, sometimes also on the sides (see below),  $2\frac{1}{2}$  mm long.

Distr. Tropical Africa, Mascarene Islands, tropical Asia from the Himalaya southwards to Ceylon and eastwards to Burma, Southern China, Indo-China and Siam, to Queensland, and the Carolines (Yap), throughout *Malaysia*, also in Christmas Island.

Ecol. In thickets, in open grasslands, and on sand-banks, from sea-level to 50 m.

Use. A poultice of the leaves, with turmeric and broken rice, is used upon chapped hands and feet. Animals eat the plant; even if given nothing else, may thrive on it (BURKILL).

Vern. *Ramijo*, Djambi, *aroj djonong gedé*, *tatapajan*, S. lawatan, J. *kělēmibiet*, W. Borneo.

Note. On account of the pubescence of the seeds two forms can be distinguished:

*f. pubescens* OOSTSTR. *Blumea* 3 (1939) 307. Seeds shortly pubescent or nearly glabrous over the whole surface, or with only some slightly longer reddish brown hairs at the hilum and the margins.—Fig. 24c.

*f. barbata* OOSTSTR. *Blumea* 3 (1939) 307. Seeds shortly pubescent, the hilum and the margins with long hairs; sometimes these long hairs are also found on the sides.—Fig. 24d.

These forms can only be distinguished when ripe seeds are available. As the type specimen described by BURMAN, and preserved at Geneva, has no ripe seeds, it is impossible to decide to which of the two forms it belongs.

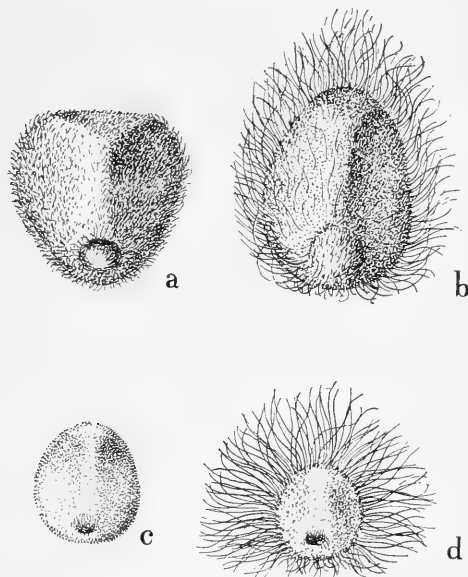


Fig. 24. *a-b. Merremia umbellata* (L.) HALLIER *f.*, *a.* seed of *ssp. umbellata*, *b.* seed of *ssp. orientalis* (HALLIER *f.*) OOSTSTR.,  $\times 5$ .—*c-d. Merremia hederacea* (BURM. *f.*) HALLIER *f.*, *c.* seed of *f. pubescens* OOSTSTR., *d.* seed of *f. barbata* OOSTSTR.,  $\times 5$ .

in the latter case the first ramification of the peduncle dichasial, the subsequent ones often monochasial. Pedicels 2–4 mm, smooth or minutely tuberculate. Bracts narrow-obovate, mucronulate, 3 mm long, caducous. Flower-buds oblong to broadly elliptic, obtuse. *Sepals* glabrous or occasionally slightly pilose on the back and along the margins, concave, broadly obovate to spatulate, broadly notched at the apex, distinctly mucronulate, the mucro directed outwards; two outer sepals  $3\frac{1}{2}$ –4 mm, inner ones to 5 mm long. *Corolla* campanulate, 6–10(–12) mm long, yellow, outside glabrous, inside with long hairs near the hairy base of the filaments. Ovary glabrous. *Capsule* broadly conical to depressed-globular, somewhat 4-angular, ca 5–6 mm high, 4-valved, the valves

**3. *Merremia hirta* (L.) MERR.** Philip. J. Sc. 7 (1912) Bot. 244; *ibid.* 59 (1936) 452, t. 1; OOSTSTR. *Blumea* 3 (1939) 307, f. 1, k; f. 2, P-W.—*Convolvulus reptans* LINNÉ, Sp. Pl. (1753) 158, excl. syn. RHEED.—*Convolvulus hirtus* LINNÉ, Lc. 159.—*Convolvulus caespitosus* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 70.—*Ipomoea linifolia* BL. Bijdr. (1825) 721.—*Ipomoea philippinensis* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 475.—*Skinneria caespitosa* CHOISY, Lc. 487, t. 6.—*Convolvulus linifolius* (BL.) DIETR. Syn. Pl. 1 (1839) 675, non LINNÉ 1759, nec WALL. 1828.—*Convolvulus hybridus* ZOLL. & MOR. Nat. Geneesk. Arch. N.I. 2 (1845) 6.—*Ipomoea setulosa* ZOLL. & MOR. in MOR. Syst. Verz. (1846) 51.—*M. caespitosa* HALLIER *f.* Bot. Jahrb. 16 (1893) 552.—Fig. 25.

#### KEY TO THE VARIETIES

1. Inner sepals oblong or elliptic-oblong, obtuse.  
*var. hirta*
1. Inner sepals broadly elliptic to subquadrate, truncate to retuse and mucronulate at the apex.  
*var. retusa*

*var. hirta*.—Fig. 25.

A twining or prostrate herb; the prostrate specimens rooting at the nodes or sometimes at the

internodes. Stems slender, 20–50 cm long, filiform, sparsely patently hirsute or glabrous. *Leaves* very variable in form, linear, linear-oblong, oblong-lanceolate, oblong to ovate-oblong or ovate, occasionally orbicular to subquadrate; the narrow leaves 3–6 by  $1\frac{1}{3}$ –1 cm, 5–12 times as long as broad, the broad ones  $1\frac{1}{2}$ – $4\frac{1}{2}$  by  $\frac{4}{5}$ – $2\frac{1}{2}$  cm, 1–5 times as long as broad, rounded, truncate, more or less cordate or hastate at the base with small or large, obtuse, spreading or parallel basal lobes, obtuse to slightly emarginate and mucronulate at the apex, the surfaces glabrous or sparsely hairy beneath and along the margins, sometimes also above, rarely the indumentum is more developed, especially on stems, petioles, leafblades and basal part of peduncles; petiole short, (1–

3–8(–20) mm. *Peduncles* filiform, variable in length,  $1\frac{1}{2}$ –7 cm, glabrous or with a few hairs near the base. *Flowers* 1 to few, mostly up to 4, in some specimens to 8; the ramifications of the peduncle monochasial (racemelike and unilateral), or the first ramification dichasial and the subsequent ones monochasial. *Pedicels* 3–5 mm, glabrous. *Bracts* ovate, obtuse, 1–2 mm long, glabrous, persistent. *Flower-buds* oblong to elliptic, obtuse. *Sepals* glabrous, unequal, the 2 outer ones shorter, elliptic, obtuse, 3–4 mm long, the 3 inner oblong or elliptic-oblong, obtuse,  $4\frac{1}{2}$ –6 mm long; sepals slightly enlarged in fruit, to 6–7 mm, with more or less prominent nerves. *Corolla* broadly funnel-shaped,  $1\frac{1}{2}$ –2 cm long, pale-yellow or whitish, glabrous, midpetaline bands in dried state with distinct dark nerves. *Filaments* hairy at the base; anthers spirally twisted. *Ovary* glabrous, 2-celled. *Capsule* broadly ovoid to globular, with a thin papery wall, smooth, glabrous, crowned by the base of the style, ca 6 mm long, 1-celled, 4-valved. *Seeds* 4 or less, dark brown or black, glabrous or sparsely floccose at the margins and the hilum.

*Distr.* India to Southern China, Siam, and tropical Australia, throughout *Malaysia*.

*Ecol.* In open grasslands, along waysides, in dry rice-fields, from sea-level to 1100 m.

*Vern.* *Rebha teng-ketteng*, Md.

*var. retusa* OOSTSTR. *Blumea* 3 (1939) 311, f. 2, X–Z.—? *Ipomoea hepaticifolia* BLANCO, *Fl. Filip.* ed. 2 (1845) 72; see note.

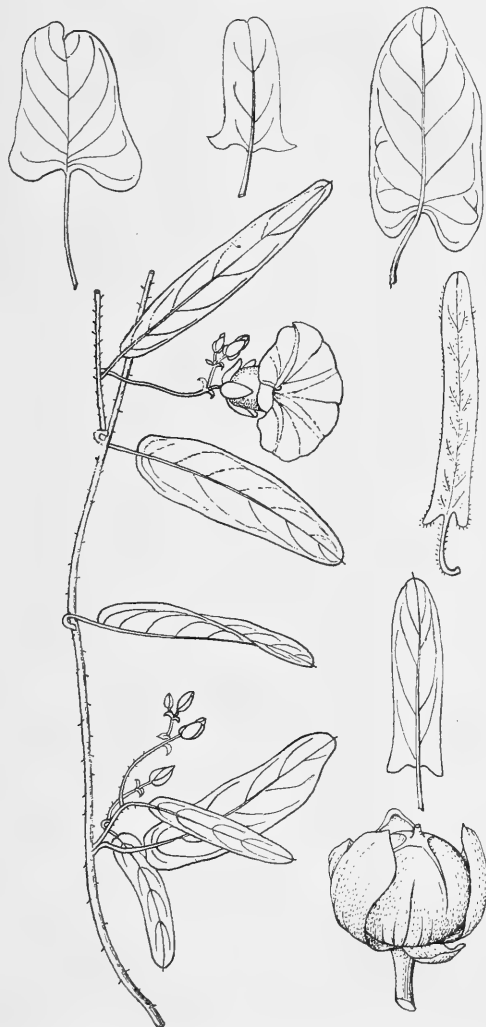
Differs from *var. hirta* by having the inner sepals broader, broadly elliptic to subquadrate, with a truncate to retuse, mucronulate apex, and the outer ones elliptic, obtuse to acutish, mucronulate. *Leaves* oblong,  $\frac{4}{5}$ – $2\frac{1}{2}$  cm long, hastate at the base, with entire or 1–2-dentate lobes, obtuse to subretuse and mucronulate at the apex. *Peduncles* short, to 1 cm long, 1- or sometimes 2–3-flowered.

*Distr. Malaysia:* Philippines (Luzon).

*Note.* The specimen MERRILL, Sp. Blanc. 679 from Luzon (prov. of Bulacan, Angat), was distributed by that author as an illustrative specimen of *Ipomoea hepaticifolia* BLANCO. See MERRILL, Sp. Blanc. (1918) 324. On account of BLANCO's short and incomplete description it is, however, impossible to verify MERRILL's opinion.

**4. *Merremia dichotoma* OOSTSTR.** *Blumea* 3 (1939) 311, f. 1, b–c.—**Fig. 26.**

Stems twining, slender, minutely tuberculate; sparsely hirsute, glabrescent or glabrous. *Leaves* ovate, 4–7 by  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm, cordate at the base with rounded basal lobes, gradually attenuate towards the obtuse mucronulate apex, entire, glabrous; lateral nerves 8–10 on either side of the midrib; petiole  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, glabrous or sparsely hairy towards the apex. *Inflorescences* glabrous, 6–15 cm long, peduncles terete, smooth, 4–7 cm, 1–3 times dichasially ramified at the apex, the ultimate ramifications monochasial, all with oblong to ovate, concave, 2–4 mm long, persistent bracts. *Pedicels* 5–6, in fruit to 8–9 mm long. *Flower-*



**Fig. 25. *Merremia hirta* (L.) MERR.** Flowering branch and various shapes of leaves, nat. size; capsule,  $\times 2\frac{1}{2}$ .

buds obtusish. *Sepals* glabrous, unequal, 2 outer ones shorter, 4 mm long, oblong to oblong-elliptic, obtuse, mucronulate, inner ones 6 mm long, broadly ovate to orbicular, obtuse or subretuse. *Corolla* broadly funnel-shaped, ca 18 mm long, white, glabrous, inside below the hairy base of the filaments with two rows of hairs; the broad basal pilose part of the filaments with an incurved appendage at the apex. *Ovary* glabrous. *Capsule* subglobular, mucronate, ca 7 mm high, 2-celled, 4-valved; valves reticulately wrinkled. *Seeds* 2 in each cell, ca  $3\frac{1}{2}$  mm long, dull black, pubescent, villous at the edges.

*Distr. Malaysia:* Lesser Sunda Islands (Central Timor, only once collected on the S. coast near Kolbano).

*Vern. Knâtan*, Timor.

**5. *Merremia emarginata* (BURM. f.) HALLIER f.** Bot. Jahrb. 16 (1893) 552; OOSTSTR. *Blumea* 3 (1939) 312.—*Evolvulus emarginatus* BURM. f. Fl. Ind. (1768) 77, t. 30, f. 1.—*Convolvulus reniformis* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 67.—*Ipomoea reniformis* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 446.—*Convolvulus excisus* ZIPP. Linnaea 15 (1841) 338, *pro syn.*—*Lepistemon reniformis* HASSK. Pl. Jav. Rar. (1848) 524.

A perennial herb. Stems prostrate, rooting at the nodes, sparsely hairy and glabrescent, 30–75 cm long, the adult parts sometimes warty. *Leaves* kidney-shaped to broad-ovate,  $\frac{1}{2}$ – $2\frac{1}{2}$  (– $3\frac{1}{2}$ ) by  $\frac{2}{3}$ – $2\frac{1}{2}$  (– $3\frac{1}{2}$ ) cm, cordate at the base with a broadly rounded sinus and rounded basal lobes, obtuse to broadly rounded or slightly emarginate at the apex, coarsely crenate or entire, glabrous or sparsely appressed pilose; petiole about as long as the blade or shorter,  $\frac{1}{5}$ – $2$  (– $3\frac{1}{4}$ ) cm long, shortly hairy or minutely verrucose. *Flowers* axillary, solitary, or in 2–3-flowered cymose clusters; peduncle very short to nearly absent. *Pedicels* 2–4 mm. *Bracts* small, ovate to linear, acute, hairy. *Flower-buds* globular, obtuse. *Sepals* obovate to orbicular or subquadrate, the outer ones  $2\frac{1}{2}$ –3 mm long, obtuse with a cucullate and distinctly mucronate top, the inner ones 3–4 (–6) mm long, deeply emarginate, all more or less hairy on the back and long ciliate at the margins. *Corolla* tubular-campanulate, 5–9 mm long, glabrous, yellow with a paler base, the midpetaline bands distinctly 5-nerved and suffused purple outside; the limb slightly 5-lobed; corolla hairy inside at the hairy base of the filaments. *Ovary* glabrous. *Capsule* subglobular, 5–6 mm diam., longitudinally sulcate, glabrous, brownish black or black, crowned by the thickened smooth base of the style, at the base enclosed by the sepals. *Seeds* 4 or less, ca  $2\frac{1}{2}$  mm long, greyish brown, glabrous, dotted.

*Distr.* Tropical Africa, tropical Asia, in



Fig. 26. *Merremia dichotoma* OOSTSTR. Flowering branch,  $\times \frac{2}{3}$ , and capsule,  $\times 2$ .

*Malaysia:* Java, SE. Borneo, Celebes (Donggala, Pasui), the Lesser Sunda Islands (Timor, Sumbawa), and the Philippines (Luzon). According to MERRILL (Sp. Blanc. 1918, 324) the species has all the appearance of being an introduced one in the Philippines, as it occurs only in the settled areas.

*Ecol.* Restricted to regions with a rather strong to very strong dry season, on rather heavy soils, in fields and open grasslands, along railroads and in waste places, from sea-level to 200 m.

*Use.* In the Philippines the leaves and tops in decoction are sometimes used as a diuretic, and in Java for coughs.

*Vern.* *Embun*, *pégagan utan*, *paschaga-utan-ketjil*, J; Philippines: *bato-bato*, Tag., *kupit-kupit*, Il.

*Note.* There is a certain resemblance of the vegetative parts with those of the Umbellifer *Centella asiatica* URB. The species has sometimes been confounded in the herbaria with *Dichondra repens* FORST.

## 2. Section Streptandra

HALLIER f. Bot. Jahrb. 18 (1894) 114; OOSTSTR. *Blumea* 3 (1939) 315.

*Flower-buds* ovoid or conical, mostly acute; midpetaline bands in the dried state often with 5 dark lines; flowers of moderate size or large.

**6. *Merremia tridentata* (L.) HALLIER f.** Bot. Jahrb. 16 (1893) 552; OOSTSTR. *Blumea* 3 (1939) 315.—*Convolvulus tridentatus* LINNÉ, Sp. Pl. ed. 1 (1753) 157.—*Evolvulus tridentatus* LINNÉ, l.c. ed. 2 (1762) 392.—*Ipomoea tridentata* ROTH in ROEM. Arch. Bot. 1, 2 (1798) 38.—**Fig. 27.**

KEY TO THE SUBSPECIES

1. Outer sepals mostly obtuse to emarginate at the apex, inner ones attenuate-acuminate with an acute apex. Corolla 10–12 mm long. Filaments inserted *ca* 1½ mm above the corolla-base. Leaves mostly obtuse, truncate or emarginate at the apex . . . . . *ssp. tridentata*
1. All sepals attenuate-acuminate to the apex with an acute point. Corolla 12–20 mm long. Filaments inserted *ca* 3 mm above the corolla-base. Leaves mostly attenuate towards the acute apex . . . . . *ssp. hastata*

*ssp. tridentata*.—*M. tridentata* HALLIER f. *ssp. genuina* OOSTSTR. *Blumea* 3 (1939) 315, f. 2, J-N.—*M. tridentata* HALLIER f. var. *genuina* HALLIER f. ex OOSTSTR. l. c. 315, pro syn.—**Fig. 27 b'-b'''**.

A prostrate herb. Stems 10–80 cm long, angular, glabrous, several from a stout perpendicular root. Leaves glabrous, linear (or in some specimens nearly filiform), linear-oblong to oblanceolate, spatulate or subquadrate, 4–20(–30) by (½–) 1½–4(–6) mm, base not or slightly broadened, truncate to hastate, basal lobes as far as present spreading or parallel, with 1 tooth or with a few teeth, leaf-margin above the base entire or slightly crenate to dentate, apex obtuse, truncate or emarginate and mucronulate to tridentate (occasionally part of the leaves has the apex acute and mucronulate); petiole ½–2 mm or nearly absent. Flowers in 1–2(–3)-flowered cymes. Peduncles axillary, ¼–1½(–2) cm long, glabrous or pubescent near the base. Pedicels 4–8 mm long, glabrous, angular, thickened above in fruit. Bracts minute, oblong, mucronulate. Flower-buds narrowly conical, acute. Outer sepals mostly shorter than inner, 3–4 mm long, oblong, obtusish, obtuse to emarginate, mucronulate; inner ones 4–6 mm long, lanceolate, attenuate-acuminate into a slender point; occasionally the outer sepals are more acute at the apex, more rarely the outer as well as the inner sepals are obtuse and mucronulate (so in specimens from India). Corolla funnel-shaped, 10–12 mm long, glabrous, completely yellow, yellowish white or white, or with a purple centre. Filaments inserted *ca* 1½ mm above the corolla-base, glabrous or sparsely hairy at the slightly dilated base. Ovary glabrous. Capsule ovoid, 4–5 mm long, 4-valved, pericarp papery, glabrous, straw-coloured. Seeds 4 or less, 2–2¼ mm long, dull black, glabrous.

Distr. Tropical Africa, Mascarene Islands, tropical Asia from Bengal and Central Provinces southwards to S. India and Ceylon, eastwards to Malaysia: Malay Peninsula, Anambas Islands, Riouw Archip., Banka, SW. Celebes (once near Pasui), and S. Moluccas (Aru Islands).

Ecol. Sandy places near the coast; the collection from Celebes more inland, at 600 m.

Vern. *Kong kong pasir*, Mal. Pen..

*ssp. hastata* (DESR.) OOSTSTR. *Blumea* 3 (1939) 317, f. 2, O.—*Convolvulus hastatus* DESR. in LAMK, Enc. 3 (1789) 542, non FORSK. 1775, THUNB. 1794, SIEB. ex CHOISY, 1845.—*Convolvulus blumei* DIETR. Syn. Pl. 1 (1839) 675.—*Ipomoea blumei* STEUD. Nom. ed. 2, 1 (1840) 815.—*M. hastata*

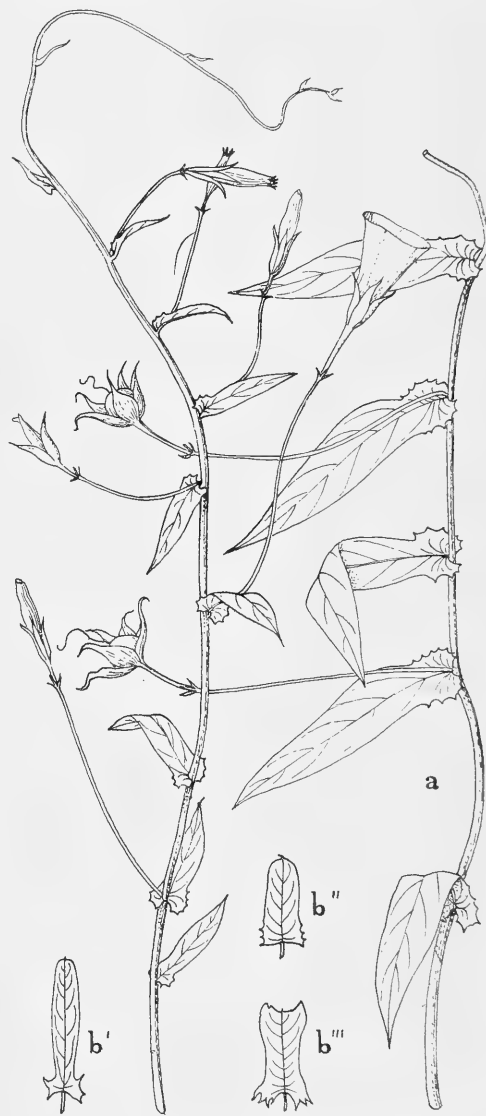


Fig. 27. *Merremia tridentata* (L.) HALLIER f., a. Flowering and fruiting branches of *ssp. hastata* (DESR.) OOSTSTR., nat. size, b'-b''' leaves of *ssp. tridentata*, nat. size.

HALLIER f. Bot. Jahrb. 16 (1893) 552.—Fig. 27a.

A herbaceous twiner, occasionally prostrate. Stems one or several from a stout perpendicular root, 60–200 cm, slender, more or less angular to subulate, glabrous. Leaves mostly glabrous, narrowly oblong, linear-oblong, linear or sometimes (especially the upper ones, or occasionally all) narrow-linear, larger than in *ssp. tridentata*, 25–80(–100) by  $1\frac{1}{2}$ –15(–20) mm, more or less contracted above the base, with more or less stem-clasping, obscurely to sharply dentate basal lobes, leaf-margin above the base entire or indistinctly undulate, blade gradually attenuate towards the distinctly mucronulate, sharply acute, or obtuse or rarely emarginate apex; petiole nearly absent or very short, 1–3 mm. Flowers in one- to few-flowered cymes. Peduncles axillary, 1–8 cm long, thin, glabrous, or mostly pubescent near the base. Pedicels as long as or longer than the calyx, glabrous, angular, 6 mm long or longer, thickened above in fruit and to 15 mm long. Bracts minute, subulate. Flower-buds narrowly conical, acute, the tips of the sepals more or less curved outwards. Sepals equal in length or the outer ones a little shorter, (5)–6–7(–10) mm long, glabrous, all lanceolate to ovate-lanceolate, attenuate-acuminate into a sharp, slender point, the margin of the sepals narrowly scarious, undulate. Corolla funnel-shaped, 12–20 mm long, glabrous, wholly pale yellow or white, or with a purple to chocolate brown centre. Filaments inserted ca 3 mm above the corolla-base, sparsely hairy at the slightly dilated base. Ovary glabrous. Capsule globose to ovoid, 4-valved, pericarp papery, glabrous; dissepiment often persistent after dehiscence. Seeds 4 or less,  $2\frac{1}{2}$ –3 mm long, dull black or dark-grey, glabrous.

Distr. Tropical East Africa, tropical Asia from the Khasia Hills and Bengal southwards to Ceylon, eastwards and southwards to China, Hongkong, Formosa, and tropical Australia, throughout Malaysia.

Ecol. On rather light soil, in open grasslands, climbing on grasses and other low herbaceous plants and shrubs, in waste places, along waysides, in along-fields, teak-forests, from sea-level to ca 1200 m.

Uses. The leaf is made into poultice and applied to the head in cases of jungle-fever (Mal. Pen.).

Vern. *Akar keremak*, *karok relia*, *pungulang*, Mal. Pen., *sanem-sanem*, *kangkong rimbu*, *akar tali tali*, Sum. W. coast, *tulan dalin*, Djambi, *klitang*, *djangut boang*, Banka, *irit-iritan*, *rangitan*, *pakissan rambat*, J, *kitjoke*, Md, *djala djala*, *beja-wak*, S. Borneo, *mawow-entut*, Minah., *luré-luré*, *kradjok*, *dongi-dongi*, *lilah kali sarang*, Celebes, *djala ma tubu*, Ternate, *guwi djala*, Tidore, *saputangan dua*, Ceram; Philippines: *karadkad*, Ig., *maragta*, *talanuk*, Tag., *tatalon*, Man., *sigid*, P. Bis..

Notes. The subspecific epithet *hastata*, although based on *Convolvulus hastatus* DESR. (1789, non FORSK. 1775) is maintained as provided under art. 81 of the Code, and is treated as a new name in this rank.

BLUME, Bijdr. (1825) 721, and several authors after him incorrectly used the name *Ipomoea filicaulis* (VAHL) BL. for this taxon. Others have mentioned it as *Ipomoea angustifolia* JACQ. Both names are synonyms of *Merremia tridentata* (L.) HALLIER f. *ssp. angustifolia* (JACQ.) OOSTSTR. Blumea 3 (1939) 323, note. For more detailed data see l.c. 322–324.

7. *Merremia quinquefolia* (L.) HALLIER f. Bot. Jahrb. 16 (1893) 552; OOSTSTR. Blumea 3 (1939) 324.—*Ipomoea quinquefolia* LINNÉ, Sp. Pl. (1753) 162.—*Convolvulus quinquefolius* LINNÉ, Syst. ed. 10 (1759) 923.—Fig. 28.

A herbaceous twiner. Stems slender, glabrous or sparsely to densely hirsute with patent hairs. Leaves palmately compound, with 5 leaflets; leaflets glabrous, sessile or shortly petiolulate, oblong or narrow-oblong to lanceolate, or sometimes still narrower,  $2\frac{1}{2}$ –6 by  $1\frac{1}{2}$ –2 cm, attenuate towards both ends, acute or obtusish and mucronulate at the apex, the margins coarsely dentate to undulate or nearly entire; petiole 2–5(–9) cm, thin, glabrous or with a few patent hairs. Inflorescences axillary, to ca 12 cm long. Peduncles shorter to longer than the petioles, 4–7 cm, glandular towards the apex, the glands sometimes mixed with patent bristly hairs, 1-flowered or cymosely 3–5-flowered; branches of cyme glandular. Pedicels glabrous or with a few glands near the base, 5–7 sometimes to 15 mm long, in fruit to 15–20 mm



Fig. 28. *Merremia quinquefolia* (L.) HALLIER f. Flowering branch, nat. size.

and thickened at the apex. Bracts narrow-triangular, acute, *ca*  $1\frac{1}{2}$  mm long. Flower-buds ovoid, acute. *Sepals* narrow-ovate to oblong, obtuse, mucronulate, glabrous, subequal in length, or the outer ones shorter; outer sepals 4–6, inner 6–8 mm long, slightly enlarged in fruit. *Corolla* funnel-shaped, 18–25 mm long, glabrous, pale yellow or whitish. Filaments inserted *ca* 3–4 mm above the base of the corolla, shortly pubescent at their dilated base; anthers spirally twisted. Ovary glabrous. *Capsule* globose, straw-coloured, 4-celled, 4-valved; valves *ca* 9 mm long. Seeds 4, *ca*  $4\frac{1}{2}$  mm long, black or greyish black, shortly hairy with appressed curled hairs.

Distr. Tropical America, in *Malaysia* cultivated and occasionally run wild, introduced before 1840.

Ecol. A very rapid grower, in a short time covering all other plants; perhaps of some value as a cover-crop.

Vern. *Rau tjanga*, Ternate.

8. *Merremia quinata* (R.Br.) OOSTSTR. *comb. nov.*—*Ipomoea quinata* R.Br. Prod. (1810) 486; BTH. Fl. Austr. 4 (1869) 415; F.v.M. Descr. Notes Pap. Pl. 3 (1876) 44; WARB. Bot. Jahrb. 18 (1894) 207; BAILEY, Queensl. Fl. 4 (1901) 1057; SCHUM. & LAUT. Fl. Deut. Schutzgeb. (1901) 517; OOSTSTR. Blumea 3 (1940) 581.—*Ipomoea quinata* R.Br. l.c. 486.—*Convolvulus quinatus* SPRENG. Syst. 1 (1825) 590.

Stems twining, slender, glabrous, or more or less hirsute with long, spreading hairs. *Leaves* palmately compound, with 5 leaflets; leaflets mostly glabrous, linear, lanceolate or narrowly oblong,  $2\frac{1}{2}$ – $3\frac{1}{2}$  by  $1\frac{1}{4}$ – $3\frac{1}{4}$  cm, obtuse or obtusish and mucronulate at the apex, narrowed towards the base, entire; petiole 1– $1\frac{1}{2}$  cm, glabrous or hirsute. *Peduncles* axillary, shorter to longer than the leaves, glabrous, or hirsute near the base, mostly 1-flowered. Pedicels glabrous, 8–9 mm long. Bracts ovate, acuminate, *ca* 3–4 mm long. *Sepals* ovate to ovate-oblong, obtuse, glabrous; two outer ones  $7\frac{1}{2}$ – $8\frac{1}{2}$  mm long; three inner ones longer, *ca* 10–13 mm. *Corolla* campanulate to funnel-shaped, up to 5 cm long, white or pale pink. Filaments inserted *ca* 6–7 mm above the base of the corolla. Ovary glabrous, 2-celled. *Capsule* *ca* 12 mm long, ovoid, somewhat acuminate. Seeds glabrous. (Description partly after ROBERT BROWN, BENTHAM, and BAILEY, l.c.).

Distr. N. Australia, Queensland, in *Malaysia*: New Guinea (NE. New Guinea; Yule Island; Jervis Island), Philippines (Luzon). Also mentioned from Burma and S. China, but it is not quite certain that these specimens are conspecific.

9. *Merremia tuberosa* (L.) RENDLE in Fl. Trop. Afr. 4, 2 (1905) 104; OOSTSTR. Blumea 3 (1939) 325.—*Ipomoea tuberosa* LINNÉ, Sp. Pl. (1753) 160, non LOUR. 1790.—? *Convolvulus paniculatus* BLANCO, Fl. Filip. (1837) 96.—*Ipomoea tuberosa* L. var. *oligantha* HASSK. Retzia 1 (1855) 69.—*Operculina tuberosa* MEISSN. in MART. Fl. Bras. 7 (1869) 212.—Fig. 29.

A glabrous perennial twiner. Stems from a large

subterranean tuber, robust, terete, finely striate. *Leaves* orbicular in outline, 6–16 cm long and as broad, palmately divided to far below the middle; segments 7, oblong-lanceolate, acuminate at the apex, narrowed to the base, entire, the middle segment larger than the lateral ones; petiole 6–18 cm, slender. *Peduncles* axillary, few- to several-flowered, terete or more or less applanate to the apex, 4–15 cm long. Pedicels 15–18 mm, clavate, in fruit to 5 cm. Bracts triangular, *ca* 2 mm long. Two outer *sepals* 23–25 mm long, ovate to broadly ovate, obtuse, indistinctly minutely mucronate; three inner ones narrower, oblong; sepal 3 about

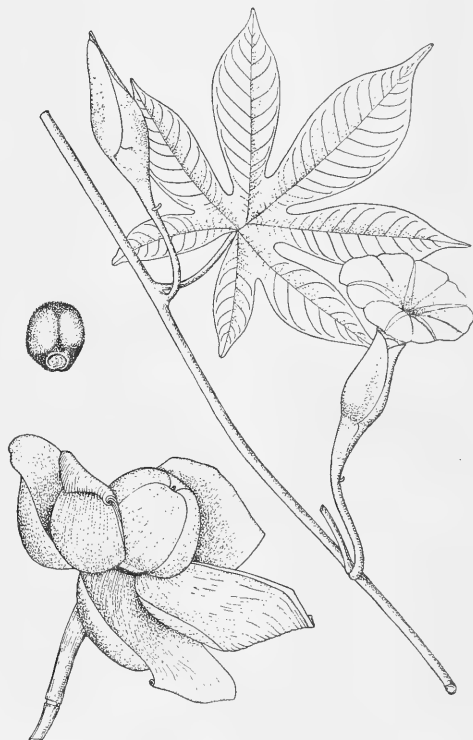


Fig. 29. *Merremia tuberosa* (L.) RENDLE. Flowering branch, capsule, and seed,  $\times \frac{1}{2}$ .

as long as the two outer ones; two inner sepals *ca* 21–22 mm long; all sepals in fruit to 5–6 cm long, enclosing the capsule. *Corolla* funnel-shaped, *ca*  $5\frac{1}{2}$  cm long, glabrous, yellow. Anthers twisted. *Capsules* 4- or less-seeded; the 4-seeded ones subglobose to depressed-globose, *ca*  $3\frac{1}{2}$  cm diam., the less-seeded ones ellipsoid, ellipsoid-globose or oblique-ellipsoid, with a smaller diameter; the thin, straw-coloured pericarp splits more or less irregularly and moreover loosens circumscissile at its base. Seeds *ca* 17 mm long, black, with a black pubescence on the sides and with somewhat longer black hairs along the margins, glabrescent.

Distr. Probably of tropical American origin; distributed through tropical Africa, the Mas-



carene Islands, India, Ceylon; in *Malaysia* cultivated and rarely escaped.

Ecol. From sea-level to ca 600 m. Corolla open in the early morning.

Vern. *Aroy kawoyang*, S.

Note. Though the capsule-wall loosens as a whole at its base from the receptacle and forms in this way a kind of 'operculum', it is completely different from that, found in *Operculina*. In the latter the wall shows two distinct layers; the outer of these, the exocarp, is fleshy in the upper part forming a circumscissile lid (*operculum*), while the scarious endocarp remains entire, to split at length irregularly.

**10. *Merremia aegyptia* (L.) URBAN, Symb. Antill.** 4 (1910) 505; OOSTSTR. *Blumea* 3 (1939) 327.—*Ipomoea aegyptia* LINNÉ, Sp. Pl. ed. 1 (1753) 162.—*Convolvulus pentaphyllus* LINNÉ, Sp. Pl. ed. 2 (1762) 223.—*Ipomoea pentaphylla* JACQ. Collect. 2 (1788) 297.—*Batatas pentaphylla* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 436.—*M. pentaphylla* HALLIER f. Bot. Jahrb. 16 (1893) 552.

Stems twining, slender, terete, hirsute with yellow-brown patent hairs. *Leaves* palmately compound, with 5 leaflets; leaflets appressed-pilose on both surfaces, sessile, elliptic or elliptic-oblong,  $2\frac{1}{2}$ –10 by 1–4 cm, acute at the base, acute or acuminate at the apex, entire; petiole slender, as long as or longer than the blade,  $2\frac{1}{2}$ –12 cm long, patently hirsute. *Peduncles* axillary, few- to several-flowered, 5–24 cm long, patently hirsute like the 10–25 mm long pedicels. Bracts lanceolate, 2–4 mm long, caducous. Three outer *sepals* 15–25 mm long, ovate-lanceolate, acute or acuminate, densely hirsute; two inner ones slightly shorter, ovate, acute, glabrous. *Corolla* funnel-shaped,  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long, glabrous, white. Anthers spirally twisted. Ovary glabrous, 4-celled. *Capsule* globose, glabrous, 4-celled, 4-valved. Seeds 4, glabrous.

Distr. Circumtropical, in *Malaysia* perhaps formerly cultivated.

**11. *Merremia dissecta* (JACQ.) HALLIER f.** Bot. Jahrb. 16 (1893) 552 (*sphalm. dissecta*); OOSTSTR. *Blumea* 3 (1939) 328.—*Convolvulus dissectus* JACQ. Obs. 2 (1767) 4.—*Ipomoea sinuata* ORTEGA, Hort. Matr. Dec. 7 (1798) 84.

Stems twining, slender, terete, striate, patently hirsute with yellowish hairs, the adult parts woody, glabrescent and warted. *Leaves* palmately divided nearly to the base, with 5–7 lanceolate, mucronulate, coarsely dentate to irregularly pinnately lobed segments, glabrous or hairy on the veins beneath, the middle segment  $2\frac{1}{2}$ –10 by  $\frac{1}{2}$ –3 cm, the lateral ones smaller; petiole  $2\frac{1}{2}$ –7 cm, patently hirsute like the stems. *Peduncles* axillary, one- to few-flowered, 5–10 cm long, patently hirsute, glabrescent in the upper portion. Pedicels  $1\frac{1}{2}$ –2 cm long, thickened towards the calyx, glabrous, minutely verrucose at the apex. Flower-buds narrow-ovoid, acute. *Sepals* subequal, 2– $2\frac{1}{2}$  cm long, ovate-lanceolate, acute, mucronulate, glabrous, herbaceous with narrow scarious margin, enlarged and coriaceous in fruit. *Corolla* funnel-

shaped, 3– $3\frac{1}{2}$  cm long, white with a rose-purple throat; the limb with 5 distinct bands. Anthers spirally twisted. Ovary glabrous, 2-celled. *Capsule* globose, glabrous, 2-celled, 4-valved. Seeds normally 4, glabrous, black.

Distr. Probably indigenous only in America from the Southern United States to Argentina and Uruguay, elsewhere in the tropics and in *Malaysia* cultivated as an ornamental and occasionally escaped.

Vern. *Noon-flower*, E.

**12. *Merremia vitifolia* (BURM. f.) HALLIER f.** Bot. Jahrb. 16 (1893) 552; OOSTSTR. *Blumea* 3 (1939) 329.—*Convolvulus vitifolius* BURM. f. Fl. Ind. (1768) 45, t. 18, f. 1.—*Convolvulus angularis* BURM. f. l.c. 46, t. 19, f. 2.—*Ipomoea vitifolia* BL. Bijdr. (1825) 709.—*Ipomoea vitifolia* BL. var. *angularis* CHOISY in DC. Prod. 9 (1845) 361.

A large twiner. Stems terete, the older ones striate, 2–4 m, glabrous or patently hirsute with white or fulvous hairs. *Leaves* orbicular in outline, 5–18 by 5–16 cm, cordate at the base, palmately 5–7-lobed; lobes broad-triangular to lanceolate, more or less acuminate or acute to obtuse at the apex and mucronulate, mostly not contracted at the base or sometimes slightly so, coarsely dentate to crenate, or subentire, sparsely to densely hairy on both sides, more densely beneath than above, or glabrous above; petiole 2–15 cm, occasionally longer, patently hairy or glabrous. *Peduncles* axillary, 1–3- or several-flowered, shorter or longer than the petiole, 1–15 cm or more, patently hirsute. Pedicels 8–20 mm, hirsute like the peduncles, thickened towards the apex, clavate in fruit. Bracts subulate,  $1\frac{1}{2}$ –2 mm. Flower-buds narrow-ovoid, acute. *Sepals* oblong to ovate-oblong, obtuse or acutish, mucronulate, the outer ones more or less hirsute, glabrescent, the inner ones glabrous, all with glandular pellucid dots, 12–20 mm long, in fruit to 20–25 mm and then thick, subleathery, whitish inside and with many glandular pits. *Corolla* funnel-shaped, 4–6 cm long, glabrous, bright-yellow, paler towards the base; the limb with 5 obtuse lobes, midpetaline bands distinctly 5-nerved. Anthers spirally twisted. Ovary glabrous. *Capsule* subglobose, ca 12 mm high, papery, straw-coloured, 4-valved. Seeds 4 or less, 6–7 mm long, dull black or blackish-brown, glabrous.

Distr. From India and Ceylon to Indo-China and the Andamans, throughout *Malaysia*.

Ecol. Both in regions with a feeble and in those with a rather strong dry season, in open grasslands, thickets, and hedges, along fields, in teak-forests, along edges of secondary forests, on river-banks and waysides, from sea-level to ca 900 m.

Use. It is used for poulticing, and an infusion is drunk for high fever (BURKILL).

Vern. *Akar lulang bulu*, *ulan raya*, Mal. Pen., *areuj kawojang*, S, *ginda pura utan*, *katapong*, *tampar kidang*, *ojod kotong*, *katong*, *samber kidang*, *Jg, dewulu*, *pos sepo*, *subulu*, Md, *rabet bulu*, Kangean, *taradju*, *tjambulu-bulu*, *kai-kai mamia*, Celebes, *takwaha*, Sula, *kalalakmit*, Sulu, *lakmit*, Tag.

3. Section *Xanthips*

(GRISEB.) HALLIER f. Bot. Jahrb. 16 (1893) 552; OOSTSTR. Blumea 3 (1939) 333.—*Ipomoea* sect. *Xanthips* GRISEB. Fl. Br. West Ind. Isl. (1864) 470.

Flower-buds ovoid, obtuse or subacute; midpetaline bands indistinctly defined, never with dark lines; flowers of moderate size.

**13. *Merremia umbellata* (L.) HALLIER f.** Bot. Jahrb. 16 (1893) 552; OOSTSTR. Blumea 3 (1939) 333, f. 1, p; f. 2, A-I.—*Convolvulus umbellatus* LINNÉ, Sp. Pl. (1753) 155.—*Ipomoea pilosa* HOUTT. Nat. Hist. II, 7 (1777) 573, t. 42, f. 2.—*Convolvulus cymosus* DESR. in LAMK, Enc. 3 (1791) 556.—*Ipomoea umbellata* G. F. W. MEY. Prim. Fl. Esseq. (1818) 99.—*Ipomoea cymosa* (DESR.) R. & SCH. Syst. 4 (1819) 241.—*Ipomoea cymosa* BL. Cat. 's Lands Pl.-tuin (1823) 50, note.—*Ipomoea cymosa* R. & SCH. var. *pilosa* & var. *sagittata*-*angulata* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 462 & 463.—*Ipomoea cymosa* R. & SCH. var. *sagittata* CHOISY in DC. Prod. 9 (1845) 371.—*Ipomoea sepriaria* (non KOEN.) ZOLL. & MOR. Syst. Verz. (1845–46) 51.—*Ipomoea modesta* CHOISY in ZOLL. Syst. Verz. 2 (1854) 129, 131.—*Ipomoea cymosa* R. & SCH. var. *typica* PRAIN, J. As. Soc. Beng. 63 (1894) 108.—*M. umbellata* HALLIER f. var. *orientalis* HALLIER f. Versl. 's Lands Pl.-tuin 1895 (1896) 132; *ibid.* Bull. Soc. Bot. Belg. 35 (1896) 270.—**Fig. 24a–b; 30.**

*ssp. orientalis* (HALLIER f.) OOSTSTR. stat. nov. (var. *orientalis* HALLIER f., l.c.).—**Fig. 24b; 30.**

Stems herbaceous, or the older parts woody, the young parts with a white milky juice, twining or prostrate and rooting, slender, 1–3 m, terete or slightly striate, softly pubescent or glabrescent to glabrous. *Leaves* variable in shape and size, 4–12 (–16) by 1–6½ (–9) cm, ovate, ovate-oblong or oblong, more or less cordate at the base or rounded to truncate, the basal lobes rounded or angular, sometimes hastate; more or less acuminate at the apex with obtuse, mucronulate top; lower surface sparsely to densely covered with short, soft, greyish or whitish hairs; upper surface mostly less densely hairy to glabrous; lateral nerves 5–7 (–9) on either side of the midrib; tertiary nerves many, subparallel; petiole pubescent or glabrous, variable in length, 1½–6 cm. *Peduncles* axillary, mostly short, 1–4, rarely to 7 cm long, mostly densely pubescent, mostly cymosely branched at the apex with short branches; cymes mostly few- to many-flowered, umbelliform, rarely 1-flowered. Pedicels mostly longer than the calyx, sparsely pubescent to glabrous. Bracts minute, lanceolate, caducous. Flower-buds ovoid, obtuse or acutish. *Sepals* slightly unequal, the outer ones somewhat shorter than the inner, or subequal, very concave, broad-elliptic or orbicular, rounded or emarginate, mucronulate, 5–7 (–8) mm long, the inner ones scarious at the margin, all glabrous or the outer ones sparsely pilose, often pectinately erose and slightly enlarged in fruit. *Corolla* funnel-shaped, 2–3, sometimes to 3½ cm long, white or yellow to orange, glabrous except for the upper parts of the midpetaline bands; limb slightly lobed. Anthers straight. Ovary glabrous or sparsely hairy at the top. *Capsule* ovoid to conical,

mucronate by the style-base, glabrous or sparsely hairy at the top, 10–12 mm high, ca 8 mm diam., 4-valved, valves lanceolate to narrow-ovate, splitting from the base. Seeds 4 or less, ca 5 mm long, densely hairy with long soft patent hairs.

Distr. Tropical East Africa, the Seychelles, India, Ceylon, eastwards to China, Indo-China, Siam and Queensland; throughout *Malaysia*. Fig. 30. The *ssp. umbellata* (var. *occidentalis* HALLIER f.) occurs in America from Mexico to Paraguay, in the West Indies and in tropical W. Africa. See further under Notes.

Ecol. In thickets, along edges of forests, in grasslands, along fields, along waysides, from sea-level to ca 1100 m.

Uses. The young leaves may be mixed with vegetables and eaten. The pounded leaves may be used as a poultice for burns and scalds. They are used as poultices for sores in the Moluccas (BURLING; HEYNE).

Vern. *Akar bungah kuning*, *akar ulan tapak pelandok*, *akar lakoon*, *akar liha patong*, *akar ulan bitina*, Mal. Pen., *andur nasi*, Toba-Batak, *akar kalimanan*, *akar mantji*, *ubi-ubi*, *akar bulu*, Sum. W. coast, *akar slemang*, *baju seluang*, *akar seluang*, *rawatan*, Palembang, *akabulu*, *akar itang*, Djambi, *akar biabak*, Banka, *areuj kidang*, *areuj retu(n)*, *areuj jeuteum*, *tatapajan*, *areuj geureung*, *areuj bulu*, S, *ojod kedangan*, M, *lawatan kebo*, warungan, J, *rabet saobi sabbian*, Kangean, *akar laren*, *lankal lankal*, Br. N. Borneo, *akar endit*, Kutai, *pala parang*, *rongo*, *ampas-ampas*, *uwi-im-pager*, *katama*, *timbohu kusu*, Celebes; Philippines: *bangbañgau*, Il., *kalamitmit*, Tagb., *kamokamothan*, Pamp., Tag., *malakamóte*, Pamp., *tukod-tukod*, P. Bis.; *petatas utan*, Ambon, *daun bisul* (*bissol*), Moluccas, *maboka*, NE. New Guinea.



Fig. 30. *Merremia umbellata* (L.) HALLIER f. *ssp. orientalis* (HALLIER f.) OOSTSTR. Distribution of specimens with yellow to orange and with white corollas. y: corolla yellow or orange; (y): corolla rarely yellow or orange; w: corolla white, (w) corolla rarely white.

Notes. The specimens from Malaysia belong to *ssp. orientalis* with the exception of a specimen from Depok, W. Java (KOORDERS 31153) which most probably represents *ssp. umbellata*.—Fig. 24a. This subspecies is of a more robust habit, with larger leaves, the peduncles are longer, and generally more-flowered, the flowers are larger, sepals 7–10 mm long; corolla always yellow; moreover, the capsule is subglobose instead of ovoid to conical (ca 15 mm diam.), with broader, ovate valves, and the seeds are not so long villose, but pubescent to short-tomentose and only with slightly longer hairs at the margins. Another specimen, mentioned by the present author in Blumea 3 (1939) 341, collected by KEULEMANS, appears

to have been found in Ilha do Principe (Prinsen-eiland), off the Westcoast of Africa (cf. Bull. Bot. Gard. Btzig III, 18, 1950, 466).

*Ssp. umbellata* has a yellow corolla; the majority of the specimens of *ssp. orientalis* in the eastern part of Malaysia have white flowers; completely or partly yellow to orange ones are found in the western part of this region, although white corollas also occur there. Fig. 30. In *M. peltata* (L.) MERR. there is a remarkably conform parallel variation in the colour of the corolla: the majority of the specimens in the western part of Malaysia have yellow flowers, whereas in the eastern part the corolla seems to be constantly white. Fig. 31.

#### 4. Section Hailale

HALLIER f. Bot. Jahrb. 49 (1913) 379; OOSTSTR. Blumea 3 (1939) 342.

Closely related to *sect. Xanthips*: Mostly large woody twiners. Inflorescences corymbose, often forming terminal panicles; lower bracts often foliaceous. Flowers of moderate size or large. Buds ovoid or narrow-ovoid, acute or acutish, rarely subglobular. Midpetaline bands mostly not with distinct dark lines.

14. *Merremia boisiana* (GAGNEP.) OOSTSTR. Blumea 3 (1939) 343.—*Ipomoea boisiana* GAGNEP. Not. Syst. 3 (1914) 141.

##### KEY TO THE VARIETIES

1. Branches, petioles and peduncles glabrous or nearly so. Leaves glabrous . . . *var. boisiana*
1. Branches, petioles, peduncles and leaves more or less densely greyish or fulvous pubescent. . . . . *var. sumatrana*

*var. boisiana*.

A large woody twiner; branches terete or slightly striate, fistulose, glabrous, greyish brown to brownish black. Leaves broad-ovate to orbicular, 8–14 by 7–12 cm, cordate to truncate at the base, acuminate to cuspidate at the apex, glabrous; midrib and 7–9 lateral nerves on either side prominent beneath, impressed above, secondary nerves parallel, prominulous beneath, slightly impressed above, tertiary nervation finely reticulate, prominulous above; petiole to 7 cm long, glabrous or sparsely pubescent near the apex. Inflorescences axillary, corymbosely ramified at the apex, several-flowered; peduncle terete and glabrous in the basal part, more or less applanate and pubescent to the apex, 9–13 cm long. Pedicels slightly thickened towards the calyx, sparsely pubescent, to 8(–12) mm. Bracts narrow-triangular, 1–1½ mm long, caducous, the lower ones sometimes foliaceous. Flower-buds subglobose. Sepals subequal in length or the outer ones slightly shorter, 5–7 mm long, concave, glabrous or the outer ones slightly pubescent; outer sepals orbicular to transverse-elliptic, rounded or slightly retuse at the apex, inner ones transverse-elliptic. Corolla broadly funnel-shaped to campanulate, ca 22 mm long, yellow (in the Tonkin specimen), or white (in the Sumatran one); midpetaline bands sericeous outside. Filaments curved at the dilated papillose

base; the corolla inside with two longitudinal hairy lines below the place of insertion of each filament; anthers straight, finally twisted. Ovary glabrous. Capsule (acc. to GAGNEPAIN) ovate-conical, 4-valved, glabrous, castaneous at the base, yellow upwards.

Distr. Indo-China (Tonkin), in Malaysia: Sumatra (East Coast).

Ecol. Edge of clearing, ca 900–1050 m.

Note. The specimen from Sumatra (YATES 975) is almost entirely identical with the type (Bois 138) from Tonkin; the lower surface of the leaves of the Tonkin specimen is, however, somewhat more glaucous than in that from Sumatra. The specimen BECCARI 3594, from Borneo, mentioned by GAGNEPAIN, belongs to *M. crassinervia* OOSTSTR.

*var. sumatrana* OOSTSTR. Blumea 3 (1939) 344.

Differs from *var. boisiana* by the grey to fulvous pubescent, afterwards glabrescent branches, petioles, peduncles, and pedicels, by the leaves being densely greyish pubescent on both sides, and becoming glabrous above.

Distr. Malaysia: Sumatra (East Coast: Sibolangit).

Ecol. In young forest and thickets, ca 500–600 m.

Note. Specimens of this variety are to 20 m high; the leaves may reach a length of 20 cm and 16 cm diam., petiole to 10 cm long, inflorescences 8–16 cm long.

15. *Merremia mammosa* (LOUR.) HALLIER f. Teysmannia 7 (1897) 164; OOSTSTR. Blumea 3 (1939) 345.—*Convolvulus mammosus* LOUR. Fl. Cochinch. 1 (1790) 108.—*Ipomoea mammosa* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 475.—*Ipomoea go-mezi* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 211.

A glabrous twiner with subterranean, fusiform to globose, fasciculate, *ca* 10–25 cm long tubers, containing a white milky juice. Stems annual, terete, brown, finely striate in the older parts. *Leaves* broad-ovate to orbicular or sometimes broader than long, 6–12 by  $4\frac{1}{2}$ –12(–15) cm, cordate at the base, abruptly acuminate at the apex, with a narrow, obtuse, mucronulate acumen; margin entire or slightly undulate; lateral nerves 7–9 on either side of the midrib, 3–4 of them from near the base; secondary nerves many, parallel; tertiary nervation reticulate; petiole slender, to 6, or sometimes to 10 cm long or more. *Inflorescences* axillary. Peduncle terete, or angular near the apex, 3–15 cm, 1–3- or sometimes more-flowered. Pedicels thickened and angular towards the apex, 12–15 mm. Bracts linear-lanceolate or lanceolate, 7–10 mm long, membranous, caducous. Flower-buds narrow-ovoid, acute. *Sepals* concave, about equal in length, 24–30 mm long, the 3 outer ones broad-ovate to broad-elliptic, obtuse, mucronulate, the inner ones narrower and less obtuse. *Corolla* broadly funnel-shaped, 7–8 cm long, white, glabrous but with minute glands outside; mid-petaline bands distinctly nerved. Base of the filaments decurrent with a row of hairs on either side; anthers spirally twisted. Ovary glabrous. *Capsule* enclosed by the persistent calyx. Seeds 8 mm long, greyish to black, with long brownish hairs along the margins.

*Distr.* India, Indo-China, Andamans, in *Malaysia*: cultivated in Java, formerly also in Bali, the Moluccas, and the Philippines (acc. to RUMPHIUS); occasionally escaped (Madura).

*Use.* The tubers are edible, they are also used as a native anti-diabetes remedy; and in affections of the throat and the respiratory organs, or in cases of lung-tuberculosis.

*Vern.* *Bidara upas*, M, *widara upas*, *wirodjo*, *blanar*, J, *rabèt belading*, Md, *ubi sufu*, Moluccas, *bangkuwang*, Bali (RUMPHIUS), *hailalé*, Ambon (RUMPHIUS, HEYNE), *angcoa*, Philip. (RUMPHIUS).

**16. *Merremia borneensis* MERR.** Univ. Calif. Publ. Bot. 15 (1929) 260; OOSTSTR. *Blumea* 3 (1939) 347.

A large woody quite glabrous twiner, stems *ca* 2 cm diam.. Branches terete, fistulose, pale to dark brown, warty by pale lenticels. *Leaves* more or less bullate, orbicular, or rarely ovate, (5)–8–22 by  $(3\frac{1}{2})$ –6–18 cm, cordate at the base, cuspidate at the apex with a long and narrow mucronulate acumen, sometimes acuminate and less distinctly cuspidate; midrib and (6)–8–11 curved lateral nerves on either side prominent beneath, secondary nerves parallel, prominent beneath; tertiary nerves reticulate, conspicuous; petiole 4–11 cm. *Inflorescences* axillary. Peduncle 6–12 cm long, several-flowered, lenticellate, cymosely branched towards the apex. Pedicels  $1\frac{1}{2}$ –3 cm, angular, thickened above, especially in fruit. Bracts caducous. Flower-buds ovoid to oblong, acute. *Sepals* elliptic to broad-elliptic, obtuse to slightly emarginate at the apex, mucronulate, (15)–18–22 mm long, the two outer ones leathery, the inner

ones more or less membranous, all slightly accrescent in fruit. *Corolla* campanulate to funnel-shaped,  $5\frac{1}{2}$ –6 cm long, yellow, outside glabrous, inside papillose below the base of the filaments. Filaments glabrous; the corolla inside above the insertion of the filaments with a semicircular thickening. Ovary glabrous, 4-celled. *Capsule* ovoid, *ca* 12 mm high, mucronate, glabrous, black. Seeds oblong-ovoid, *ca* 6–7 mm long, pale, appressed-pilose.

*Distr. Malaysia*: Malay Peninsula (Tringganu), W., NW, and N. Borneo.

*Ecol.* Forming tangled masses over thickets, especially along small streams.

*Vern.* *Pohon lapa gaga*, Mal. Pen., *akar larum*, *laran*, Br. N. Borneo, Mal.

**17. *Merremia pulchra* OOSTSTR.** *Blumea* 3 (1939) 348, f. 3, a-c.

Most probably a large twiner, quite glabrous. Branches terete, greyish brown, with sparse, pale lenticels. *Leaves* ovate, 7–11 by  $5-6\frac{1}{2}$  cm, cordate at the base, abruptly acuminate at the apex, with an acute, *ca* 1 cm long acumen; midrib and 6–7 lateral nerves on either side slightly impressed above, prominent beneath; secondary nerves nearly parallel, slightly prominulous above, flat beneath; tertiary nerves indistinctly reticulate; petiole sulcate above,  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm long. *Inflorescences* *ca* 8–20 cm long, racemously ramified; peduncle *ca* 3–6 cm, terete, lower branches 3–7, upper  $2\frac{1}{2}$ –5 cm long, 1-flowered. Pedicels  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, angular and thickened towards the apex. *Sepals* thinly coriaceous, or the inner ones membranous, equal in length or the outer ones slightly shorter, 25–30 mm long, oblong to elliptic-oblong, obtuse at the apex and mucronulate. *Corolla* broadly funnel-shaped, *ca* 6 cm long, glabrous.

*Distr. Malaysia*: Borneo (N. Sarawak); a specimen collected in the Philippines by G. T. LAY, without indication of the exact locality (Herb. Brit. Mus.) seems to be conspecific.

*Note.* The type specimen from P. Muara, Brunei Bay, in Herb. Singapore, possesses one open flower, glued upon the sheet; therefore I could not examine details.

**18. *Merremia crassinervia* OOSTSTR.** *Blumea* 3 (1939) 350, f. 1, a.

A woody quite glabrous twiner. Branches terete, solid or fistulose, greyish brown, warty by pale lenticels. *Leaves* ovate to broadly ovate, 7–13 by  $3\frac{1}{2}$ –9 cm, cordate at the base, attenuate or slightly acuminate towards the obtuse or acutish apex; margin entire or slightly undulate; midrib and 8–10 curved lateral nerves on either side impressed above, prominent beneath; secondary nerves parallel, like the reticulate tertiary ones slightly impressed above, prominulous beneath; petiole narrowly sulcate above,  $1\frac{1}{2}$ –5 cm long. *Inflorescences* axillary, up to 20–30 cm long, widely corymbosely branched, many-flowered; lower branches in the axils of small caducous leaves, upper ones in the axils of minute bracts. Peduncle 7–11(–17) cm, terete. Pedicels up to 15 mm, slightly

angular. Flower-buds conical, acute. *Sepals* subequal in length, 11–12 mm long, the two outer ones elliptic, rounded and mucronulate at the apex, concave, subcoriaceous; 3 inner ones broadly elliptic to orbicular, rounded and mucronulate at the apex, and with membranous margins. *Corolla* funnel-shaped, ca 2–2½ cm long, glabrous, the limb shallowly lobed. Filaments papillose at the margins of the dilated base. Ovary glabrous.

Distr. *Malaysia*: Borneo (Sarawak).

**19. *Merremia clemensiana* OOSTSTR.** Blumea 3 (1939) 350, f. 1, d.

A woody twiner. Branches terete, slightly striate, glabrous or pubescent towards the apex, minutely warty by pale lenticels. *Leaves* ovate to broadly ovate, 5–14 by 3–10 cm, rounded at the base, gradually attenuate or shortly acuminate towards the obtuse mucronulate apex, glabrous; midrib and 5–6 curved lateral nerves on either side impressed above, prominent beneath; secondary nerves nearly parallel, prominent on both sides or indistinct above; tertiary nerves reticulate, prominent above, flat beneath; petiole 1–3 cm, narrowly sulcate above, glabrous. *Inflorescences* axillary, more or less secund, to 12 cm long, corymbosely branched at the apex, many-flowered; peduncles to 8 cm, terete, glabrous or pubescent towards the apex; branches of the inflorescences short, pubescent. Pedicels 12–16 mm long (in fruit 25–35 mm), glabrous or pubescent at the base, slightly thickened and subangular at the apex. Lower bracts foliaceous, to 3–5 cm long, upper ones subulate, ca 1½ mm long. Flower-buds ovoid, acute to obtusish. *Sepals* glabrous, two outer ones subcoriaceous, broadly oblong, rounded at the apex, ca 7 mm long, three inner ones broadly elliptic to orbicular, retuse at the apex, 8–9 mm long, subcoriaceous in the middle portion, and with membranaceous margins. *Corolla* campanulate to broadly funnel-shaped, ca 1½ cm long, yellow (or sometimes white?), glabrous, limb hardly lobed, crenulate(?). Dilated base of the filaments curved, and papillose at the margins; anthers straight. Ovary glabrous. *Capsule* ca 12–13 mm high, straw-coloured, 4-, or by splitting of the valves, more-valved; valves at the apex with a sharp incurved tooth. Seeds ca 6 mm long, densely covered with long blackish brown or greyish brown soft hairs.

Distr. *Malaysia*: Borneo (Sarawak).

Ecol. Scandent in thickets and open forests.

**20. *Merremia korthalsiana* OOSTSTR.** Kew Bull. (1938) 175; Blumea 3 (1939) 351.

A large woody twiner. Stems terete or obtusely angular, substriate, greyish brown when dry, glabrous or slightly pubescent in the younger parts; the adult stems fistulose, to 7 mm diam. *Leaves* broadly ovate or orbicular, 6–15 by 4–14 cm, broadly cordate or truncate at the base, abruptly acuminate or cuspidate at the apex with a narrow, acute, 1–1½ cm long acumen, glabrous and dull or more or less shining above, paler beneath and there pubescent on the nerves or glabrous; midrib

and 7–10 lateral arcuate nerves on either side often subimpressed above, prominent beneath; secondary nerves subparallel, prominulous above, prominent beneath; tertiary nerves reticulate, prominulous above; petiole 2½–6 cm long, substriate and slightly sulcate above, glabrous or sparsely hairy in the groove. *Inflorescences* axillary, corymbosely branched at the apex, to 20 cm long, secund, or often forming a more or less umbelliform panicle at the end of the branches; peduncle to 12 cm, pubescent or glabrous, longitudinally striate; primary branches many, in the axils of foliaceous bracts, pubescent, 1½–4 cm long, cymose at the apex with several flowers. Pedicels 12–20 mm long, pubescent. Upper bracts small, linear-subulate, 2½–4 mm, pubescent. Flower-buds ovoid, acutish. *Sepals* black when dry, shining, broad-elliptic or orbicular, broadly rounded at the apex, mucronulate or not so, outside glabrous, inside with many minute resinous dots, equal in length or the outer ones slightly shorter, 9–10 mm long. *Corolla* broadly funnel-shaped or campanulate, 2–2½ cm long, yellow, shallowly lobed, outside glabrous, inside with some hairs below and between the bases of the filaments. Filaments papillose at the margins of the slightly broadened base; anthers straight, glabrous. Ovary glabrous.

Distr. *Malaysia*: Borneo (Indonesian Borneo, Sarawak).

Ecol. Mostly in secondary forests, between 150 and 300 m.

**21. *Merremia peltata* (L.) MERR.** Interpr. Rumph. Herb. Amb. (1917) 441; OOSTSTR. Blumea 3 (1939) 352.—*Convolvulus peltatus* LINNÉ, Sp. Pl. (1753) 1194.—*Ipomoea nymphaefolia* BL. Bijdr. (1825) 719, non GRISEB. 1866.—*Ipomoea peltata* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 452.—*Chironia capsularis* BLANCO, Fl. Filip. ed. 1 (1837) 102.—*Chironia lanosantha* BLANCO, l.c. ed. 2 (1845) 71.—*Operculina peltata* HALLIER f. Bot. Jahrb. 16 (1893) 549.—*Merremia nymphae(i)-folia* HALLIER f. Versl. 's Lands Pl.-tuin 1895 (1896) 127.—*Ipomoea menispermacea* DOMIN, Bibl. Bot. Heft 89 (1929) 535, f. 177.—**Fig. 31.**

A large twiner, to 30 m high, covering whole trees, rarely procumbent. Stems from a large subterranean tuber, terete, fistulose or pithy, containing a milky juice, glabrous, or hairy at the base of the petioles, the thickest parts striate. *Leaves* peltate, broadly ovate to orbicular or even broader than long, 7–30 by 7–30 cm, rounded or slightly retuse at the base (the leaves of the inflorescences sometimes cordate at the base and not or indistinctly peltate), acuminate or abruptly cuspidate at the apex, with an acute and mucronulate acumen; glabrous on both surfaces or slightly hairy beneath along the nerves, rarely on the whole surface; lateral nerves 7–10 on either side of the midrib; secondary nerves many, parallel; finer nervation reticulate; petiole shorter or longer than the blade, 3–20 cm long or more, glabrous. *Inflorescences* to 40 cm long, widely corymbose, several- to many-flowered; peduncles axillary,

1–2 in a leaf-axil, stout, terete. Pedicels  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, thickened and angular at the apex, in fruiting stage clavate and to 5 cm. Bracts caducous. Flower-buds narrow-ovoid, acute. *Sepals* (15–) 18–25 mm long, equal in length or the outer ones slightly shorter; three outer sepals broad-ovate, subcoriaceous; two inner ones narrower, ovate-oblong, thinner, all mucronulate at the obtuse apex. *Corolla* broadly funnel-shaped,  $4\frac{1}{2}$ –6 cm long, yellow or white, limb shallowly lobed. Filaments dilated and hairy in the basal part; corolla inside above the insertion of each filament with a semicircular thickening; anthers spirally twisted, hairy. Ovary glabrous. *Capsule* 4-celled, 4-valved; valves splitting longitudinally into several segments. Seeds 4, densely yellowish to dark-brown tomentose and long-villose.

Distr. Madagascar, Mascarenes, Seychelles, N. & E. tropical Australia, Polynesia; throughout *Malaysia*. Fig. 31.



Fig. 31. *Merremia peltata* (L.) MERR. Distribution of specimens with yellow, and with white corollas. y: corolla yellow, (y): corolla rarely yellow; w: corolla white, (w): corolla rarely white.

Ecol. Edges of primary and secondary forests, clearings, thickets, from sea-level to ca 700 m.

Uses. The tubers are reputed edible, but may cause purging. The Sundanese use an extract for stomach-ache. The juice of the stems is taken for coughs, diarrhoea, and worms; and is used for sore eyes. RUMPHIUS states that the juice of the stems may be applied to fresh wounds, and dropped into sore eyes. The leaves are used for washing the hair, and are applied as poultices on sore breasts, ulcers, and wounds (BURKILL; HEYNE). In the Philippines the stems are sometimes used for tying purposes (BROWN, QUISUMBING).

Vern. *Akar ulan*, *akar ulan gajah*, Mal. Pen., *akar sambang*, W. Sum., *rabana uding*, Simalur, *akar lonkembang*, Palembang, *ritang*, *melading*, Banka, *areuj tjarajun*, *areuj ki parumpung* or *ki palumpung*, S. klurak, *kangkung tirtu*, *akar belaran*, J. bukalung, Bali, *blaran*, SE. Borneo, *akar kachangbing*, *akar laran*, N. Borneo, *balanteteh*, *talabo*, Celebes, *wanaring*, *manaring*, *tichinin*, Minahassa, *bura' an'a*, Talaud, *afay*, Sula, *dau rambut*, *obat rambut*, *halen*, *hailalé*, Ambon, *long*, *kugè*, *kugètè*, Halmahera, *koegè*, Ternate;

Philippines: *budakin*, Bag., *bulakán*, Tag. & Bis., *bulak-bulakán*, Bik., *burákan*, S. L. Bis., Bik. & Sulu, *tampinita*, Sub.

Note. Yellow-flowered specimens appear to be restricted, with a few exceptions, to W. Malaysia, whereas white-flowered ones occur in E. Malaysia. Fig. 31. A similar distribution of the flower-colour is found in 13. *M. umbellata*. Fig. 30.

22. *Merremia elmeri* MERR. Univ. Calif. Publ. Bot. 15 (1929) 261; OOSTSTR. Blumea 3 (1939) 358.

A large woody twiner; stems, inflorescences and lower surface of the leaves, especially the nerves greyish pubescent to villose (or plant quite glabrous: var. *glaberrima* OOSTSTR.). Stems stout, terete or slightly flattened, to 5–7 mm diam. *Leaves* peltate, broadly ovate to orbicular, 6–25 by 5–21 cm, rounded to slightly retuse at the base, more or less abruptly acuminate to cuspidate at the apex, with a narrow and acute acumen; lateral nerves 8–10 on either side of the midrib, curved at the margin; secondary nerves many, parallel, tertiary nerves reticulate; petiole shorter to longer than the blade, 3–20 cm or more, glabrous or sparsely pubescent. *Inflorescences* 7–25 cm long, solitary or in pairs in the leaf-axils, more or less secund; peduncles terete or flattened at the apex, pubescent and glabrescent like the stems, patent, corymbosely branched from ca 5–15 cm above the base, several-flowered. Pedicels 7–15 mm long, angular, striate, sparsely hairy or glabrous. Bracts caducous, lower ones sometimes foliaceous, not peltate. Flower-buds ovoid, acute or obtusish. *Sepals* broadly elliptic to elliptic-oblong, 9–13(–15) mm, outer ones concave, obtuse, glabrous, subcoriaceous, longitudinally striate outside; inner ones thinner, obtuse or slightly emarginate, glabrous, all slightly enlarged in fruit. *Corolla* funnel-shaped to campanulate, 3– $3\frac{1}{2}$  cm long, white, except for the blackish grey basal outer parts, outside minutely granulose-glandular; limb indistinctly lobed, with ciliate margin. Filaments sparsely papillose at the margins of the broadened base; the corolla inside above the base of each filament with a semicircular thickening. Anthers twisted, villose. Ovary glabrous. *Capsule* subglobose to broadly conical, 13–14 mm diam., 2-celled, pericarp splitting into several valves; valves striate outside. Seeds 4, short-pubescent, brownish black, margins bearded with long brown hairs; seeds 5– $6\frac{1}{2}$  mm long.

Distr. *Malaysia*: Borneo (Indonesian & Br. N. Borneo).

Ecol. Thickets, in recently cleared land in rather wet places.

Note. Closely related to *M. peltata* and mainly different by its smaller flowers, of which the corolla is granulose-glandular outside.

var. *glaberrima* OOSTSTR. Blumea 3 (1939) 359, f. 3, d–m. Like the typical form of the species, but quite glabrous.

Distr. *Malaysia*: Borneo (Indonesian Borneo, Sarawak).

## 5. Section Wavula

OOSTSTR. *Blumea* 3 (1939) 266, 359.

Closely related to *sect. Xanthips*. Flower-buds ovoid to narrow-ovoid or oblong, subacute; midpetaline bands not with distinct dark lines. Inflorescences subumbelliform. Flowers moderate to large. Pedicels immediately below the calyx with a ring of small thick lobes.

23. *Merremia similis* ELMER, Leaf. Philip. Bot. 1 (1908) 335; OOSTSTR. *Blumea* 3 (1939) 359.—? *Convolvulus distillatorius* BLANCO, Fl. Filip. ed. 1 (1837) 95.—*M. distillatoria* MERR. Sp. Blanc. (1918) 325; En. Philip. 3 (1923) 360, *quoad specim.*

A twiner. Stems terete, smooth or finely striate, fistulose,  $2\frac{1}{2}$ – $4\frac{1}{2}$  mm diam., the young parts densely grey or rusty farinose, pubescent or short-tomentose, glabrescent. Leaves broadly ovate to orbicular,  $8\frac{1}{2}$ –20 by 8–20 cm, broadly cordate at the base, abruptly acuminate at the apex with a narrow acumem; densely short-tomentose on both sides in youth with short curled hairs, afterwards the upper surface glabrescent, finally with some scattered white hairs mainly along the nerves, the lower surface with a dense, short, rusty or greyish brown tomentum; lateral nerves 7–10 on either side of the midrib, curved at the margin, secondary nerves many, parallel, all distinctly prominent beneath; tertiary nervation reticulate; petiole 3–17 cm, pilose like the stems, glabrescent. Inflorescences axillary; peduncle to 30(–260) cm, terete, pilose like the stems, glabrescent, branched close to the apex; branches ca 1 cm long or slightly longer. Pedicels gradually thickened to the apex, with a thick lobed ring immediately below the calyx, farinose, glabrescent towards the apex, 2–3 cm, in fruit erect,  $4$ – $4\frac{1}{2}$  cm. Bracts elliptic, 2– $2\frac{1}{2}$  mm long, glabrous inside, short-tomentose

outside, caducous. Flower-buds narrow-ovoid to oblong, acute. Sepals concave, thin-coriaceous with a membranous margin and with glandular dots, obovate to broad-elliptic or orbicular, obtuse, or the outer ones slightly reflex, mucronulate, to 15–18 mm long, the innermost a little shorter; the calyx enclosing the fruit as a cup, with sepals to 20 mm long. Corolla broadly funnel-shaped, ca 4 cm long, white with a tinge of red, slightly 5-lobed, nearly glabrous, only with a few hairs at the top of the midpetaline bands. Filaments pilose at the somewhat broadened base; the corolla-tube inside with two hair lines below the base of each filament. Anthers twisted, glabrous. Ovary glabrous. Capsule ovoid, ca 15–18 mm long, 4-valved; the soon loosening outer layer of the valves brownish-black, afterwards the valves are straw-coloured outside, white inside. Seeds 6 mm long, black, sparsely tomentose and densely villose.

Distr. *Malaysia*: Philippines.

Ecol. In thickets and secondary forests at low and medium altitudes.

Vern. *Bulakán, burakán*, P. Bis..

Note. MERRILL assumes this species to be conspecific with *Convolvulus distillatorius* BLANCO. If this is accepted the correct name for the species would be *Merremia distillatoria* (BLCO) MERR.. However, in my opinion, this identity is not quite certain.

## 14. OPERCULINA

S. MANSO, Enum. Subst. Bras. (1836) 16; OOSTSTR. *Blumea* 3 (1939) 361.—Fig. 32–33.

Large, herbaceous twiners, the stems, peduncles, and petioles often winged. Leaves petioled, entire, angular or digitate, often cordate at the base. Flowers large, in one- to few-flowered axillary, peduncled cymes. Bracts often large, caducous. Sepals 5, large, pergameneous to coriaceous, mostly glabrous, often ventricose, often enlarged in fruit and ultimately with an irregularly lacerate margin. Corolla regular, broadly funnel-shaped or campanulate, white or yellow, glabrous, or with midpetaline bands hairy outside. Stamens 5, included; filaments adnate to the corolla-tube, filiform; anthers large, often at length spirally twisted; pollen ellipsoid, smooth. Disk annular. Ovary glabrous, 2-celled, each cell with 2 ovules; style 1, simple, filiform, included; stigma biglobular. Capsule large, dry; epicarp circumscissile in or above the middle, the upper part of it (*operculum*, lid) more or less fleshy, separating from the lower part and from the endocarp; this scarious, at length splitting irregularly. Seeds 4 or less, large, trigonous or globular, glabrous, or pilose along the edges, often dull black.

Distr. *Ca* 20 spp. in the tropics of both hemispheres.



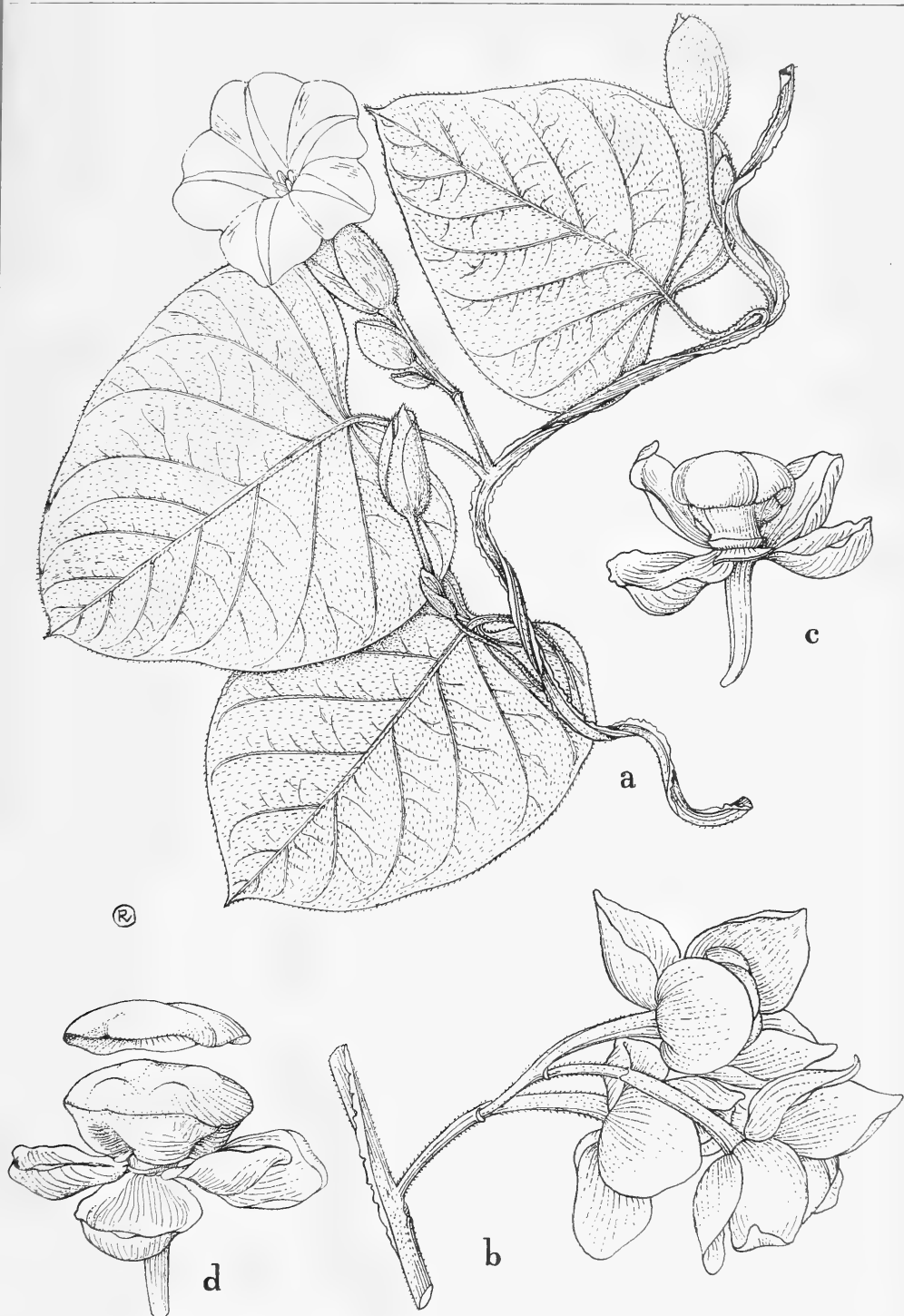


Fig. 32. *a-b. Operculina turpethum* (L.) S. MANSO. *a.* Flowering branch,  $\times \frac{2}{3}$ , *b.* infructescence,  $\times \frac{2}{3}$ .—*c-d. Operculina brownii* OOSTSTR., *c.* young capsule,  $\times \frac{2}{3}$ , *d.* capsule with operculum,  $\times \frac{2}{3}$ .



## KEY TO THE SPECIES

1. Stems terete. Midpetaline bands pilose. Sepals orbicular, broadly rounded or shallowly emarginate at the apex . . . . . 3. *O. riedeliana*
1. Stems winged, angular, or sulcate. Corolla glabrous.
  2. Outer sepals pubescent, ovate to broadly ovate, acute to shortly acuminate at the apex.
    1. *O. turpethum*
    2. *O. brownii*

**1. *Operculina turpethum* (L.) S. MANSO**, Enum. Subst. Bras. (1836) 16; OOSTSTR. Blumea 3 (1939) 362.—*Convolvulus turpethum* LINNÉ, Sp. Pl. (1753) 155.—*Convolvulus anceps* LINNÉ, Mant. 1 (1767) 43.—*Ipomoea turpethum* R.Br. Prod. (1810) 485.—*Ipomoea anceps* R. & Sch. Syst. 4 (1819) 231.—*Convolvulus maximus* BLANCO, Fl. Filip. ed. 1 (1837) 911, non LINNÉ f. 1781.—*Ipomoea reptans* (non POIR.) LLANOS, Fragm. Pl. Filip. (1851) 551.—*Ipomoea ventricosa* (non G. DON) LLANOS, l.c. 561.—*Argyreia alulata* MIQ. Fl. Ind. Bat. 2 (1857) 587.—*Ipomoea turpethum* R.Br. var. *anceps* MIQ. Fl. Ind. Bat. 2 (1857) 607.—*O. turpethum* PETER in E. & P. Nat. Pfl. Fam. 4, 3a (1891) 32.—*O. turpethum* S. MANSO var. *heterophylla* HALLIER f. Versl. 's Lands Pl.-tuin 1895 (1896) 127.—Fig. 32a–b, 33.

Perennial twiner with long fleshy much branched roots. Stems 2–4 mm high, narrowly 3–5-winged, sulcate or angular, glabrous or sparsely short-pilose, mainly at the nodes; young parts sometimes more or less tomentose. *Leaves* very variable in shape, orbicular, broadly ovate, ovate-lanceolate or lanceolate; broad leaves  $5\frac{1}{2}$ –15 by 4–14 cm, narrow ones  $5\frac{1}{2}$ – $7\frac{1}{2}$  by  $1$ – $2\frac{1}{2}$  cm; base cordate, sometimes hastate, apex acuminate, acute or obtuse to rounded, rarely slightly emarginate, mucronulate; margin entire or sometimes coarsely dentate to shallowly lobed; upper surface glabrous or appressed-pilose, lower surface pubescent; midrib and 8–11 nerves on either side prominent beneath; petiole terete or sometimes winged,  $2\frac{1}{2}$ – $7\frac{1}{2}$  cm. *Inflorescences* cymosely one- to few-flowered; peduncles 2–18 cm long, terete or sometimes winged like the stems, glabrous or pubescent. Pedicels angular, 12–15 mm or those of the central flower up to 35 mm long, pubescent, in fruit clavate and up to 40 mm. Bracts oblong or elliptic-oblong, mucronulate,  $1\frac{1}{2}$ –2 cm long, pubescent, caducous. *Sepals* ovate or broadly ovate, acute or shortly acuminate, outer ones  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm long, pubescent outside, inner ones ca 2 cm long, glabrous or nearly so; calyx in fruit broadly cup-shaped, up to 6 cm diam. *Corolla* broadly funnel-shaped, 3– $4\frac{1}{2}$  cm long, white or white with yellowish base, glabrous or sometimes with minute yellowish glands outside. Filaments sparsely pubescent below. *Capsule* depressed-globose,  $1\frac{1}{2}$  cm diam. Seeds 4 or less, 6 mm diam., glabrous, dull black.

*Distr.* Trop. E. Africa, Mascarenes, Seychelles; S. & SE. Asia to trop. Australia and Polynesia, in *Malaysia*: not yet recorded from Sumatra, ex-

tremely rare in Borneo; recently introduced in the Malay Peninsula. Introduced in the West Indian Islands. Fig. 33.

*Ecol.* Thin forests, thickets, teak-forests, hedges, along-fields, waysides, waste places, occasionally in sugar-plantations, restricted to regions with a medium or strong east monsoon; from sea-level to ca 1300 m.

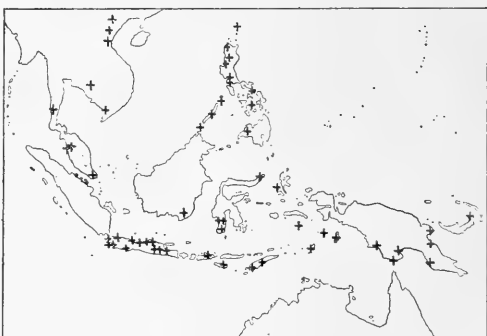


Fig. 33. *Operculina turpethum* (L.) S. MANSO. Distribution in Malaysia.

*Uses.* The bark of the roots is used as a purgative; the stems are used for tying purposes (Philippines).

*Vern.* Indian *jalap*, *turpeth-root*, E, *araj djotang benér*, S, *sampar-kédong*, *sampar-kébo*, *balaran*, *rajudan*, J, *languwi*, Sumbawa, non *loli*, Timor; Philippines: *bangbangau*, *laplapsut*, Il., *burðakan*, S. L. Bis., *kamokamothan*, Tag..

**2. *Operculina brownii* OOSTSTR.** Blumea 3 (1939) 366.—*Ipomoea alata* R.Br. Prod. (1810) 484.—*Convolvulus alatus* (R.Br.) SPRENG. Syst. 1 (1825) 596, non *Operculina alata* (HAM.) URB. 1902.—Fig. 32c–d.

A glabrous twiner. Stems angular to narrowly alate. *Leaves* narrowly ovate-oblong or ovate,  $5\frac{1}{2}$ – $8\frac{1}{2}$  by 2– $4\frac{1}{2}$  cm, long-attenuate to the acute or obtusish, mucronulate apex; midrib and 7–8 nerves on either side prominent beneath; petiole much shorter than the blade, ca 1–2 cm. *Peduncles* stout, angular or narrowly winged, 2– $3\frac{1}{2}$  cm. *Pedicels* angular, clavate above,  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, much thickened in fruit. *Sepals* broadly elliptic to orbicular, broadly rounded at the apex, 22–25 mm long; inner ones only slightly shorter than outer ones, all glabrous and all much enlarged in fruit, up to 30 mm long. *Corolla* funnel-shaped, to 5 cm

(1) According to MERRILL, En. Philip. 3 (1923) 363.

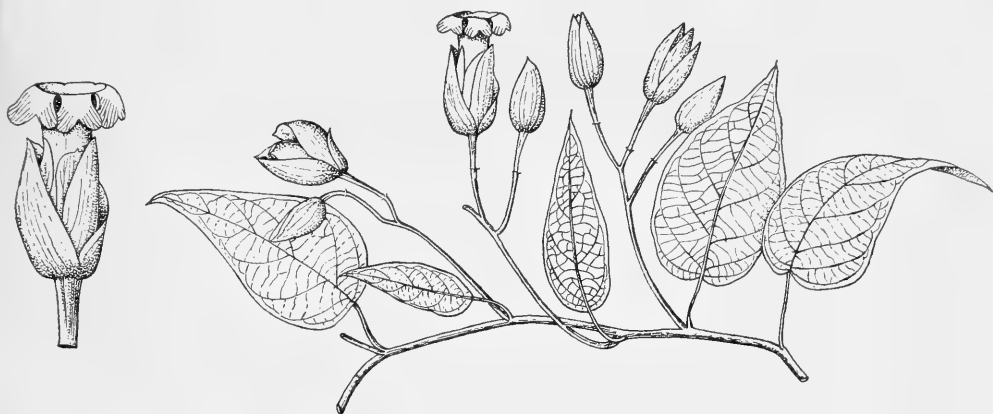


Fig. 34. *Decalobanthus sumatranus* OOSTSTR. Flowering branch,  $\times \frac{1}{2}$ , and flower, nat. size.

long (only one examined), white, glabrous. Capsule  $3\frac{1}{2}$ –4 cm diam., enclosed by the large cup-shaped calyx. Seeds ca 15 mm long, glabrous, dull black.

Distr. Australia (N. Territory, N. Queensland), Thursday Island, likely to occur in the dry savannah regions of S. New Guinea.

**3. *Operculina riedeliana* (OLIV.) OOSTSTR.** *Blumea* 3 (1939) 366.—?*Convolvulus bufalinus* LOUR. Fl. Coch. 1 (1790) 109.—?*Ipomoea bufalina* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 452.—*Convolvulus platypeltis* ZIPP. ex SPANOGHE, Linnaea 15 (1841) 338, *pro syn.*—*Ipomoea riedeliana* OLIV. in HOOK. Ic. III, 5 (1883) t. 1424.—*Merremia riedeliana* HALLIER f. Bot. Jahrb. 16 (1893) 552.—*Merremia platypeltis* PRAIN, J. As. Soc. Beng. 74, 2 (1906) 307.—*Merremia bufalina* MERR. & ROLFE, Philip. J.Sc. 3 (1908) 122, *quoad specim. tantum.*—*O. bufalina* HALLIER f. Med. Rijksherb. 1 (1910) 26, *quoad specim. tantum.*

Plant glabrous. Stems twining, robust, terete, more or less woody, fistulose or with pith. Leaves broadly ovate to orbicular, sometimes oblong or rarely narrowly oblong, occasionally contracted about the middle, 8–18 by (3)–6–15 cm, broadly cordate at the base or in narrow leaves sometimes slightly cordate to truncate, more or less abruptly acuminate at the apex, with acute mucronulate

point; often reddish brown when dry; nerves ca 7–8 on either side of the midrib; petiole thin, slender, 2–10 cm. Inflorescences one- to several-flowered. Peduncles shorter or longer than the petioles, 2–11 cm, terete at the base, applanate upwards. Pedicels 1–2(–3) cm long, clavate above, much thickened in fruit. Bracts oblong, 10–15 mm long, scarious. Sepals about equal in length, orbicular, broadly rounded or shallowly emarginate at the apex, 13–17 mm long, in fruit up to 20 mm; calyx in fruit cup-shaped and enclosing the capsule. Corolla broadly funnel-shaped, 4–5 cm long, pale yellow or rarely white; midpetaline bands densely sericeo-pilose outside. Filaments pubescent at the base as is the corolla inside below their insertion. Capsule  $2\frac{1}{2}$ –3 cm diam.; seeds ca 7 mm long, dull black, with 2 pilose-papillose edges.

Distr. Indo-China (?), in *Malaysia*: Malay Peninsula (Negri Sembilan), W. Java, S. Celebes (Palopo), Lesser Sunda Islands (Flores, Timor, Wetar), Moluccas (Buru, Key), Philippines (Luzon, Cebu), and W-E. New Guinea.

Ecol. Thickets, edges of secondary forests, hedges, at low altitudes.

Vern. *Kengkong bulit*, Mal. Pen., *bulakán-dágat*, Tag.

Note. Concerning the doubtful synonym *Convolvulus bufalinus* LOUR., see MERRILL, Trans. Am. Phil. Soc. 24, 2 (1935) 327–328.

## 15. DECALOBANTHUS

OOSTSTR. *Blumea* 2 (1936) 99, f. 1; *ibid.* 3 (1939) 370.—Fig. 34.

Prostrate, glabrous herb, with slender stems. Leaves petioled, ovate, entire. Inflorescences axillary, peduncled, cymosely 1–3-flowered. Sepals 5, large, equal in length, or the outer ones a little shorter, ovate or elliptic, obtuse or shallowly emarginate at the apex. Corolla regular, medium-sized, yellow, salver-shaped, with a fleshy long and narrowly obconical to cylindrical tube; limb 5-lobed; lobes bifid, their middle portion thicker than the oblong, obtuse lobules. Stamens 5, included; filaments flattened, adnate to the corolla-tube; pollen smooth. Disk cylindrical,

slightly lobed. *Ovary* glabrous, 2-celled, each cell with 2 ovules; style 1, simple, filiform, included; stigmas 2, globose, papillose. *Fruit* unknown.

Distr. Monotypic, endemic in *Malaysia*.

1. *Decalobanthus sumatranus* OOSTSTR. *Blumea* 2 (1936) 99, f. 1; *ibid.* 3 (1939) 370.—Fig. 34.

Herb with prostrate, thin, terete stems. *Leaves* ovate or narrowly ovate, 4–6 by 2–4 cm, truncate or slightly retuse at the base, gradually attenuate towards the obtusish mucronulate apex; midrib and 6–7 nerves on either side prominent on both sides; petiole 10–17 mm. *Inflorescences* axillary, 1–3-flowered; peduncles  $1\frac{1}{2}$ – $3\frac{1}{2}$  cm; pedicels slightly angular, thickened at the apex, 1– $1\frac{1}{2}$  cm. *Sepals* equal in length or the exterior ones a little shorter, up to nearly 20 mm long, concave; two outer ones ovate, shallowly emarginate, indistinct-

ly mucronulate, coriaceous; three inner ones elliptic, coriaceous, with membranous margins. *Corolla* salver-shaped, yellow; tube narrowly obconical to cylindrical, fleshy, up to  $2\frac{1}{2}$  cm long; limb 5-lobed, the lobes reflexed (or patent?), bifid with oblong, obtuse, ca 5– $5\frac{1}{2}$  mm long lobules. Filaments inserted ca  $6\frac{1}{2}$  mm above the corolla-base. *Ovary* glabrous, 2-celled. Disk cylindrical, slightly lobed. *Fruit* unknown.

Distr. *Malaysia*: Sumatra (Djambi).

Ecol. The only collection known was found along a wayside, on an open sunny place on weathered tuff, 60 m.

## 16. IPOMOEA

LINNÉ, *Sp. Pl.* ed. 1 (1753) 159; *Gen. Pl.* ed. 5 (1754) 76; OOSTSTR. *Blumea* 3 (1940) 481.—*Quamoclit* MOENCH, *Meth.* (1794) 453 ('*Quamoelit*').—*Batatas* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 434.—*Pharbitis* CHOISY, *l.c.* 438.—*Calonyction* CHOISY, *l.c.* 441.—*Exogonium* CHOISY, *l.c.* 443.—Fig. 35–55.

Herbs or shrubs, usually twining, sometimes prostrate, floating, or erect. *Leaves* mostly petioled, variable in shape and size, entire, lobed or divided. Petiole sometimes with pseudostipules (small leaves of the axillary shoot) at its base. *Inflorescences* mostly axillary, cymose, one- to few- or many-flowered, the cymes rarely paniculate; bracts various. *Flowers* large, medium-sized or small. *Sepals* 5, herbaceous or subcoriaceous, variable in shape and size, glabrous or hairy, persistent, often more or less enlarged in fruit. *Corolla* regular, or rarely slightly zygomorphic, usually funnel-shaped, or campanulate, more rarely tubular or salver-shaped, purple, red, pink, white or yellow; limb shallowly or rarely deeply 5-lobed; mid-petaline bands well-defined by 2 distinct nerves. *Stamens* 5, mostly inserted near the base of the corolla-tube, included or rarely exserted; filaments filiform, often dilated at the base, often more or less unequal in length; pollen globular, spinulose. Disk annular. *Ovary* usually 2-, or sometimes 4-celled, 4-ovuled, rarely 3-celled, 6-ovuled, glabrous or hairy; style 1, simple, filiform, included, rarely exserted; stigma capitate entire or often 2-, rarely 3-globular. *Fruit* a globose or ovoid capsule, mostly 4- or rarely 6-valved, or splitting irregularly. *Seeds* 4(–6) or less, glabrous or hairy.

Distr. A large genus of ca 500 spp., widely spread in the tropical and subtropical regions of both hemispheres.

Many species inhabit large or very large areas; still some of them are rare in *Malaysia*, e.g. 26. *I. diversifolia*. This phenomenon even occurs in species which are confined to the sandy sea-beach, as 22. *I. stolonifera*. A few species occupy apparently very local areas of distribution, as 16. *I. ochroleuca* which is endemic in Timor, and 17. *I. stibaropoda* which is hitherto only known from the Salajar Islands (S of Celebes).

Ecol. As a rule species of *Ipomoea* are restricted to the tropical lowland and hills, the highest locality recorded being about 1650 m altitude, or cultivated 13. *I. batatas* still higher. But further their distribution is usually not bound to special ecological niches. As is the case with the family generally, the representatives are heliophilous, hence they occur in great quantities along forest edges, in secondary forest, and in thickets which they may occasionally cover with a 'vegetable blanket' in conjunction with representatives of the *Cucurbitaceae*, *Vitaceae*, *Passifloraceae*, etc. (fig. 43).

Some species are restricted to the sandy beach, or nearly so, as 20. *I. pes-caprae*, 22. *I. stolonifera*, and 40. *I. tuba*. Specially the first species often plays a predominant part in the beach-vegetation where it is commonly associated with *Vigna*, *Canavalia*, and *Spinifex*. However, *I. pes-caprae* also occurs in-

land: some of these inland spots have been considered to represent relict localities, but, as they are situated mainly along roads and railways, dispersal through anthropogenic transport seems to be the main cause of this phenomenon. The highest locality recorded of it is along roadsides in Central Celebes at ca 200 m (see the instructive discussion by BOOBERG, Hand. 7e Ned.-Ind. Nat. Wet. Congr. 1935 (1936) 403, on the inland occurrence of the species in Java and Bali). Flowers and fruits are produced in these inland spots.

Most *Ipomoeas* grow both under everwet and seasonal climatic conditions. However, there are some species distinctly restricted to regions subject to a pronounced dry monsoon, as 1. *I. eriocarpa*, 2. *I. plebeja*, 3. *I. polymorpha*, and 27. *I. graminea*. They prefer savannah-country and grassfields (fig. 36, 37, 39).

Uses. Many species are used as ornamentals; quite a few have been imported for that aim from the New World. As food plants the most important are 19. *I. aquatica* and 13. *I. batatas*. The former is an excellent, palatable vegetable. The sweet potato is an important food plant; it is a cultigen from the New World, brought to Malaysia by the Portuguese in post-Columbian time. This origin is still reflected in several vernacular names, e.g. in 'ubi kastela' (tuber of *Castile*) and many names derived from it. It is now the main starch food of the mountain Papuans who grow it in many varieties. Some species are used in native medicine.

## KEY TO THE SPECIES

1. Sepals distinctly awned at or below the apex; awn straight or curved. Corolla salver-shaped with a long and narrow tube. Stamens and style mostly exserted.
2. Corolla rather small, 3–4½ cm long, scarlet, rarely pure white. Outer sepals 2–4½ mm long (awn exclusive), inner ones 3–6 mm (awn exclusive).
3. Leaves pinnately parted into numerous linear or filiform segments<sup>1</sup>, rarely less deeply pinnately cut. 31. *I. quamoclit*
3. Leaves not pinnately cut; ovate to orbicular, cordate at the base; margin entire or lobed. 30. *I. angulata*
2. Corolla larger, white or purplish. Outer sepals 5–12 mm long (awn exclusive), inner ones 7–15 mm (awn exclusive).
4. Corolla white; tube not or slightly widened above, 7–12 cm long; limb rotate. Stamens and style exserted . . . . . 28. *I. alba*
4. Corolla purplish, the tube distinctly widened above, 3–6 cm long, the limb funnel-shaped to rotate. Stamens and style not or scarcely exserted . . . . . 29. *I. muricata*
1. Sepals obtuse, acute or acuminate, whether or not mucronulate but not distinctly awned at or below the apex. Corolla mostly funnel-shaped, or campanulate, sometimes salver-shaped. Stamens and style mostly included, sometimes exserted. (When leaves pinnately cut, see 31. *I. quamoclit*).
5. Corolla large, 10 cm long or longer, salver-shaped with a long and narrow tube, white, or with greenish or reddish midpetaline bands. Sepals obtuse. Seeds hairy. Large twiners.
6. Stamens inserted near the mouth of the corolla-tube. Sepals subequal or outer ones slightly longer than inner, 12–18 mm long . . . . . 39. *I. aculeata*
6. Stamens inserted near the base of the corolla-tube. Outer sepals slightly or much shorter than the inner ones.
7. Outer sepals much shorter than inner ones. Leaves mostly 5(3–7)-lobed, rarely entire. Corolla white, or with reddish midpetaline bands, 11–14 cm long. Stamens exserted. 41. *I. trichosperma*
7. Outer sepals mostly slightly shorter than inner ones. Leaves mostly entire. Corolla white with greenish bands, 9–12 cm long. Stamens included . . . . . 40. *I. tuba*
5. Corolla large, medium-sized, or small, mostly funnel-shaped or campanulate, 10 cm long, or mostly shorter, rarely salver-shaped, in the latter case not longer than ca 7 cm. Sepals obtuse, acute or acuminate. Seeds hairy or glabrous. Large to small twiners, or prostrate or erect plants.
8. Sepals entirely glabrous (sometimes muricated).
9. Sepals at least 14 mm long, the outer ones with lanceolate to broadly lanceolate base, long- and gradually attenuate towards the apex . . . . . 6. *I. congesta*
9. Sepals not long- and gradually attenuate towards the apex, mostly shorter.
10. Ovary densely to sparsely hairy . . . . . 13. *I. batatas*
10. Ovary entirely glabrous.
11. Stamens exserted.
12. Leaves entire, linear . . . . . 27. *I. graminea*
12. Leaves entire, ovate to orbicular. Corolla funnel-shaped, yellow. Outer sepals not very concave, ovate to oblong, subacute, 5–6 mm long . . . . . 17. *I. stibaropoda*
12. Leaves deeply palmately lobed. Corolla salver-shaped, red or red-purple. Outer sepals distinctly concave, elliptic or ovate-elliptic, obtuse, 7–10 mm long . . . . . 34. *I. horsfalliae*
11. Stamens included.

(1) Or segments less numerous, ca 3–7 on either side of the midrib, linear or linear-lanceolate.

31a. *I. × sloteri*

13. Leaves palmately lobed to palmately compound.
14. Leaf-segments entire.
  15. Leaves palmately cut to the base. Pseudostipules (small leaves of the axillary shoot) often present. Sepals 4–6½ mm long, not very concave; outer ones ovate, obtuse or acutish, inner ones broader . . . . . **24. I. cairica**
  15. Leaves palmately lobed to or mostly beyond the middle, not to the base. No pseudostipules.
  16. Stems twining. Sepals concave, rounded at the apex, at least the inner ones orbicular; the outer ones occasionally somewhat narrower; sepals not mucronulate.
  17. Plant entirely glabrous or very sparsely pubescent with simple hairs. **32. I. digitata**
  17. Plant with stellate hairs, at least at the nodes, but mostly also on the leaves. **33. I. asterophora**
16. Stems prostrate, rooting at the nodes. Inner sepals oblong to elliptic-oblong, distinctly mucronulate.
  18. Leaves herbaceous, thin, the middle lobe acute or subacute. Corolla pink or purple. Subterranean tubers present. Cultivated, occasionally run wild . . . **13. I. batatas**
  18. Leaves fleshy, the middle lobe obtuse or emarginate. Corolla white or yellowish with a purple centre. No subterranean tubers. Plant of sandy sea-shores. **22. I. stolonifera**
14. Leaf-segments coarsely dentate to deeply and irregularly pinnatifid.
  19. Corolla less than 1½ cm long. Sepals ca 4 mm long, the back mucronate. **25. I. coptica**
  19. Corolla ca 5 cm long. Sepals 6–10 mm long, the back carinate and mucronate. **26. I. diversifolia**
13. Leaves not palmately cut.
  20. Leaves long and narrowly linear; midrib and lateral nerves nearly parallel. Corolla salver-shaped, white. Outer sepal elliptic, ca 6 mm long, inner ones oblong to ovate-oblong, 7–10 mm . . . . . **27. I. graminea**
  20. Leaves mostly broader; midrib and lateral nerves not parallel. Corolla mostly funnel-shaped, rarely salver-shaped.
    21. Corolla 7 cm or longer; at least the inner orbicular sepals ca 9–12(–18) mm long.
    22. Leaves with 3–4 nerves on either side of the midrib. Plant more or less tomentose with stellate hairs, or glabrescent to glabrous, except at the nodes. Corolla ca 7 cm long. **33. I. asterophora**
    22. Leaves with 10–15 nerves on either side of the midrib. Plant glabrous, or pubescent with simple hairs. Corolla up to 10 cm long . . . . . **36. I. illustris**
  21. Corolla mostly smaller, not exceeding 5 cm, or rarely longer, but then the inner sepals not orbicular, but narrower, 4½–6 mm long, and with distinct pale margins (see 23. *I. tricolor*).
  23. Large woody glabrous twiner; stems stout. Flowers in axillary panicles, the primary branches racemose, the ultimate partial inflorescences cymose. Leaves ovate, slightly cordate to truncate at the base; lateral nerves 11–14 on either side of the midrib. Corolla ca 2½–3½ cm long. Seeds with long silky hairs . . . . . **38. I. sumatrana**
  23. Smaller, mostly herbaceous twiners with thinner stems, or prostrate plants, glabrous or hairy. Flowers in few- to several-flowered peduncled, axillary cymes, or solitary in the leaf-axils.
    24. Corolla salver-shaped, up to 3–3½ cm long, pale lilac or white, with a purple centre. Peduncles stout, thickened towards the apex, often applanate. Outer sepals 4–6 mm long. Seeds short-tomentose, often with longer hairs along the edges . . . **18. I. maxima**
    24. Corolla funnel-shaped.
      25. Corolla up to 2½ cm long, white or pale yellow, with a purple centre. Peduncles thin, filiform. Outer sepals 3–4 mm long. Seeds puberulent . . . . . **15. I. obscura**
      25. Corolla 3 cm long or longer.
  26. Plants of marshy places or aquatic, mostly with trailing and rooting, or floating, thick, soft, fistulose or spongy stems. Leaves with truncate, cordate, sagittate or hastate base. Outer sepals 7–8 mm long, ovate-oblong. Corolla pink or pale-lilac, often with a purple centre, rarely white, 3–5 cm long . . . . . **19. I. aquatica**
  26. Terrestrial plants with twining or trailing stems; not as in *I. aquatica*.
    27. Stems mostly twining. Leaves mostly herbaceous, attenuate towards the apex, acute or acuminate, sometimes obtuse.
    28. Corolla yellow. Seeds tomentose. Sepals oblong or ovate-oblong, obtuse to truncate or slightly emarginate at the apex, subequal, 5–6½ mm long. **16. I. ochroleuca**
    28. Corolla pink, blue or purple. Seeds glabrous, puberulent or pilose along the edges only.
    29. Sepals without a distinct mucro, subequal, 4½–6 mm long, not very concave, carinate, green with pale margins. Corolla skyblue with a paler or white tube. **23. I. tricolor**
  29. At least the outer sepals distinctly mucronulate. Outer sepals mostly shorter than the inner, 6–10 mm, inner ones 8–12 mm, concave, not carinate, without a distinct pale margin. Corolla pink or purple, rarely white.

- 30. Outer sepals oblong, acute, mucronulate, inner ones elliptic, obtuse, with less distinct mucro. Corolla 4–6 cm long. Filaments sparsely pubescent nearly to the top; longest *ca* 17 mm. Pedicels 5–12 mm . . . . . 12. *I. tiliacea*
- 30. Outer sepals oblong to elliptic, acutish or obtuse, inner ones elliptic to orbicular, obtuse to emarginate, all distinctly mucronulate at or slightly below the apex. Corolla 3–4½ cm long. Filaments pubescent in the basal half; longest *ca* 6–7 mm. Pedicels 10–25(–40) mm . . . . . 14. *I. gracilis*
- 27. Stems trailing and mostly rooting at the nodes, rarely twining, mostly thick.
- 31. Leaves subcoriaceous or fleshy, mostly obtuse to broadly rounded, or emarginate at the apex. No subterranean tubers.
- 32. Corolla white or yellowish, with a purple centre. Leaves small, fleshy, very variable in shape often on the same plant, linear, lanceolate, oblong or ovate, obtuse or emarginate at the apex, obtuse or truncate or subcordate at the base; or leaves 3–5-lobed . . . . . 22. *I. stolonifera*
- 32. Corolla pink or purple. Leaves larger, subcoriaceous, kidney-shaped, orbicular, elliptic, ovate or quadrangular to oblong, broadly rounded or emarginate at the apex.
- 33. Leaves kidney-shaped, with broadly rounded apex; base cordate. Sepals unequal, the outer ones shorter, all elliptic-oblong . . . . . 21. *I. asarifolia*
- 33. Leaves orbicular, elliptic, ovate or quadrangular to oblong, emarginate at the apex; base truncate, rounded, subcuneate, or sometimes subcordate. Sepals subequal or the outer ones slightly shorter; outer sepals ovate or elliptic, inner ones broader . . . . . 20. *I. pes-caprae*
- 31. Leaves herbaceous, attenuate towards the acute or obtuse apex. Leaf-margin entire or angular (or lobed). Subterranean tubers present . . . . . 13. *I. batatas*
- 8. Sepals hairy on the outer surface, or fimbriate at the margins.
- 34. Flowers in the leaf-axils; peduncles very short, or absent. Length of corolla not exceeding 1½ cm.
- 35. Erect or ascending herb. Leaf-base acute, attenuate into the petiole. Corolla glabrous, *ca* 1¼ cm long . . . . . 3. *I. polymorpha*
- 35. Twining or prostrate herbs. Leaf-base cordate. Midpetaline bands outside at least pilose towards the apex.
- 36. Ovary and capsule hairy. Pedicels none or very short, to 3 mm. Outer sepals linear-acuminate from an ovate base. Corolla pink or purple, *ca* 7–9 mm long . . . . . 1. *I. eriocarpa*
- 36. Ovary and capsule glabrous. Pedicels 5–7 mm. Outer sepals linear-acuminate from a broadly triangular, slightly cordate to truncate base. Corolla white, *ca* 9–13 mm long. 2. *I. plebeia*
- 34. Peduncles mostly longer, well-developed. Corolla 1½ cm long, or mostly longer.
- 37. Flowers aggregate at the end of the peduncle, involucrate by large bracts.
- 38. Leaves palmately divided nearly to the base. Bracts oblong. Outer sepals lanceolate, acute. Corolla funnel-shaped, white . . . . . 8. *I. pes-tigridis*
- 38. Leaves entire. Bracts boat-shaped. Outer sepals oblong-spathulate to oblong, obtuse. Corolla salver-shaped, pink or purple . . . . . 9. *I. pileata*
- 37. Flowers whether or not aggregate at the end of the peduncle, not distinctly involucrate.
- 39. Sepals with stellate hairs . . . . . 33. *I. asterophora*
- 39. Sepals not stellately hairy.
- 40. Sepals 4 mm long or less. Corolla white or pale yellow with a purple centre. 15. *I. obscura*
- 40. Sepals 5 mm long or longer.
- 41. Outer sepals orbicular, broadly rounded at the apex.
- 42. Outer sepals 7–10(–15) mm long. Corolla glabrous. Ovary glabrous. Nerves 10–15 on either side of the midrib . . . . . 36. *I. illustris*
- 42. Outer sepals 5–6 mm long. Corolla with puberulent tube and midpetaline bands. Ovary puberulent. Nerves 7–9 on either side of the midrib . . . . . 37. *I. crassicaulis*
- 41. Outer sepals narrower, mostly acute, sometimes subobtuse.
- 43. Corolla with sericeous midpetaline bands outside. Seeds villose . . . . . 35. *I. riparia*
- 43. Corolla glabrous outside. Seeds puberulent or glabrous, sometimes pilose at the hilum or at the edges only.
- 44. Sepals long-attenuate, or long and linear-acuminate at the apex, herbaceous.
- 45. Sepals nearly linear, attenuate towards the acute apex, hirsute at the base, glabrous in the upper portion, 8–15 mm long. Corolla up to 3 cm long. Stems and peduncles filiform. . . . . 7. *I. decaisnei*
- 45. Sepals lanceolate or linear-lanceolate at the base, with a long and linear acumen, or long-attenuate towards the apex; length of sepals *ca* 15 mm or more. Corolla 5–8 cm long. Stems and peduncles thicker.
- 46. Outer sepals lanceolate at the base with a long and linear acumen, patently hirsute in the basal portion, *ca* 17–25 mm long. Corolla 5–6 cm long . . . . . 5. *I. nil*
- 46. Outer sepals lanceolate to broadly lanceolate at the base, long and gradually attenuate

- towards the apex; hairs of sepals appressed (or sepals glabrous). Sepals *ca* 14–22 mm long. Corolla 5–8 cm long . . . . . 6. *I. congesta*
44. Sepals acute or subobtus, often mucronulate, not long-attenuate towards the apex, herbaceous, membranaceous, or coriaceous.
- 47. Outer sepals herbaceous, oblong, acute, 10–15 mm long, patently hirsute in the basal portion. Corolla 5–6 cm long, mostly purple-blue, with reddish midpetaline bands, the tube paler to white . . . . . 4. *I. purpurea*
47. Sepals coriaceous or membranaceous, not or indistinctly patently hirsute in the basal portion, fimbriate at the margins. Corolla smaller.
48. Plant cultivated for its edible subterranean tubers, sometimes escaped from cultivation. Stems mostly prostrate and rooting at the nodes, thick. Leaves broad-ovate to orbicular in outline, cordate or truncate at the base, entire or angular to palmately 3–5(–7)-lobed. Corolla pale violet, 3–4<sup>1</sup>/<sub>2</sub> cm long . . . . . 13. *I. batatas*
48. No tubers. Stems mostly twining, thinner.
49. Ovary glabrous. Sepals glabrous outside, sparsely fimbriate at the margins only. Filaments sparsely pubescent nearly to the top . . . . . 12. *I. tiliacea*
49. Ovary hairy.
50. Corolla small, *ca* 1<sup>3</sup>/<sub>4</sub>–2 cm long. Flowers aggregate; branches of the cyme very short. . . . . 10. *I. triloba*
50. Corolla longer, to 3 cm. Inflorescences laxer; branches of the cyme longer. . . . . 11. *I. trifida*

### 1. Section *Calycanthemum*

(KLOTZSCH) HALLIER *f.* Bot. Jahrb. 18 (1893) 123; OOSTSTR. Blumea 3 (1940) 483, 490.—*Calycanthemum* KLOTZSCH in PETERS, Reise Mossamb., Bot. 1 (1861) 243, t. 40.

Small, mostly annual, rarely perennial pilose herbs. Stems prostrate, erect, or rarely twining. Leaves cordate or subhastate, elliptic, ovate, oblong or lanceolate, entire, or rarely pinnately lobed. Sepals ovate or lanceolate, acute, their base often broadened or auriculate. Corolla mostly small, rarely larger, mostly white or pink, sometimes purple. Seeds mostly shortly tomentose.

1. *Ipomoea eriocarpa* R.BR. Prod. (1810) 484.—*Convolvulus hispidus* VAHL, Symb. Bot. 3 (1794) 29.—*I. hispida* R. & SCH. Syst. 4 (1819) 238, non ZUCCAGNI 1809; OOSTSTR. Blumea 3 (1940) 490.—*I. sessiliflora* ROTH, Nov. Pl. Sp. (1821) 116.—*I. horsfieldiana* MIQ. Fl. Ind. Bat. 2 (1857) 611.—Fig. 35–36.

Stems herbaceous, slender, twining or prostrate, 1–2 m long, retrorsely to patently pilose. Leaves mostly lanceolate to oblong- or linear-lanceolate, 2<sup>1</sup>/<sub>2</sub>–6 by 1<sup>1</sup>/<sub>2</sub>–1<sup>1</sup>/<sub>2</sub> cm, sometimes ovate-lanceolate to ovate, 2<sup>1</sup>/<sub>2</sub>–9 by 1<sup>1</sup>/<sub>2</sub>–5<sup>1</sup>/<sub>2</sub> cm, cordate at the base with rounded sinus and basal lobes, long-attenuate to acuminate towards the apex, with an acute or obtuse mucronulate point, sparsely pilose on both surfaces or more densely beneath; nerves 7–8 on either side of the midrib; petiole shorter than or as long as the blade, <sup>3</sup>/<sub>4</sub>–8 cm, pilose. Inflorescences axillary, sessile or with a short peduncle, much shorter than the petiole, cymosely 1–3- or sometimes more-flowered. Flowers sessile or pedicels very short, to 3 mm. Bracts pilose, linear or lanceolate, lower ones



Fig. 35. *Ipomoea eriocarpa* R.BR. Branch with flowers and capsules,  $\times 1/2$ .

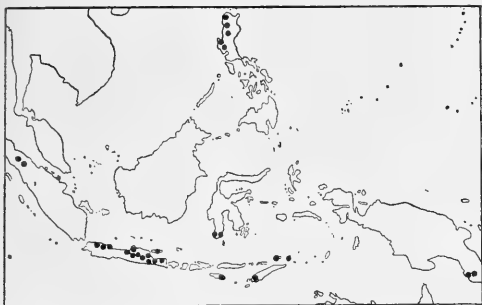


Fig. 36. *Ipomoea eriocarpa* R.Br. Distribution in Malaysia.

3–8 mm, upper ones shorter. *Sepals* pilose, about equal in length, 7–8 mm, linear-acuminate from an ovate base, the inner ones slightly narrower than the outer. *Corolla* tubular to funnel-shaped, little exceeding the sepals, 7–9 mm long, pink or purple, darker inside, the tube and the pilose midpetaline bands paler without. Stamens and style included; stamens inserted near the corolla-base, filaments glabrous, the base excepted. Ovary hairy; style hairy at the base. *Capsule* broadly ovoid to globular, ca 5–6 mm diam., shorter than the sepals, hairy, crowned by the hairy style-base, 2-celled, 4-valved. Seeds 4, ca 2½ mm long, glabrous, minutely reticulate.

Distr. Tropical Africa, Madagascar, and tropical Asia to North Australia, in *Malaysia*: not yet collected in the Malay Peninsula, Borneo, and the Moluccas. Fig. 36.

Ecol. Open grasslands, grassy waysides, thickets, hedges, fields, occasionally in secondary forests, on periodically dry soil; in regions with a fairly pronounced dry season; from sea-level to 1300 m.

Vern. *Slawatan*, J.

2. *Ipomoea plebeia* R.Br. Prod. (1810) 484; OOSTSTR. *Blumea* 3 (1940) 492.—?*Convolvulus biflorus* LINNÉ, Sp. Pl. ed. 2, App. (1763) 1668.—?*I. biflora* PERS. Syn. 1 (1805) 183, *non* R.Br.

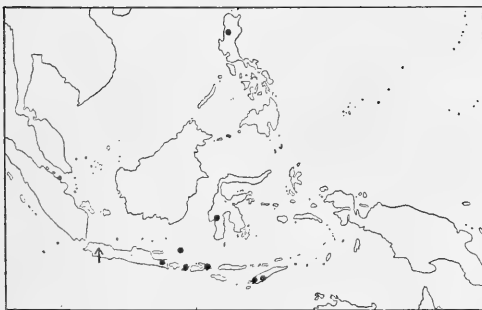


Fig. 37. *Ipomoea plebeia* R.Br. Distribution in Malaysia. The arrow indicates a presumably introduced occurrence.

1810.—*I. timorensis* BL. Bijdr. (1825) 711.—Fig. 37.

Stems herbaceous, slender, twining or prostrate, patently to retrorsely hairy. *Leaves* ovate, 3–8 by 1½–6 cm, rarely narrower, cordate at the base with a broad or narrow, rounded sinus and broad obtuse basal lobes, attenuate to short-acuminate towards the apex, with an acute or obtusish mucronulate point, sparsely pilose on both surfaces; nerves ca 5–7 on either side of the midrib; petiole



Fig. 38. *Ipomoea polymorpha* R. & SCH. Habit,  $\times \frac{1}{3}$ .

slender, shorter to longer than the blade, 1–6 cm, hairy. *Inflorescences* axillary, sessile or with a short peduncle, much shorter than the petiole, 1–2, sometimes 3-flowered. Pedicels slender, 5–7 mm, hairy. Bracts small, ca 2–2½ mm long. *Sepals* hairy, equal in length, 7–8 mm, 2 outer ones long- and linear-acuminate from a broadly triangular slightly cordate to truncate base; 2 inner ones much narrower at the base. *Corolla* tubular to funnel-shaped, little exceeding the sepals, ca 9–13 mm long, white; midpetaline bands pilose towards the top. Stamens and style included;



stamens inserted near the corolla-base, filaments glabrous, the base excepted. Ovary and style glabrous. *Capsule* broadly ovoid to globular, ca 7 mm high, little shorter than the sepals, glabrous, crowned by the style-base, 2-celled, 4-valved. Seeds 4, ca 4-4½ mm long, shortly brown to grey-tomentose and sometimes with longer white hairs along the margins.

Distr. Queensland and Malaysia: Java, Kangean, Lesser Sunda Islands (Lombok, Sumbawa, Timor), S. Celebes, Philippines (Luzon, only one record from Bontoc subprov.: VANOVERBERGH 1410). Fig. 37.

Ecol. Grasslands, dry thickets, in regions subject to a pronounced dry season, from sea-level to 600 m; rare.

Note. Though *I. biflora* (L.) PERS., described from China, is the oldest name I prefer that of R. BROWN as the identity of the former seems doubtful to me (cf. Blumea 3, 1940, 493).

3. *Ipomoea polymorpha* R. & SCH. Syst. 4 (1819) 254; OOSTSTR. Blumea 3 (1940) 493.—*I. heterophylla* R. BR. Prod. (1810) 487, non ORTEGA 1800.—*I. pumila* SPANOGHE, Linnaea 15 (1841) 341.—*Convolvulus nolanaeflorus* ZIPP. ex SPANOGHE l.c., pro syn.—*Convolvulus defloratus* CHOISY in ZOLL. Syst. Verz. 2 (1854) 130, 132.—Fig. 38-39.

Herbaceous annual. Stems erect, 8-60 cm high, simple, or branched from the base with patent or ascending branches; young parts densely pilose, adult parts less densely so to glabrous. *Leaves* narrowly elliptic, elliptic-oblong, obovate or oblanceolate, 1½-7½ by ½-3 cm, mostly attenuate towards both ends; base acute, attenuate into the petiole, apex acute or obtuse to rounded, mucronulate; margin entire, undulate or coarsely dentate, occasionally irregularly pinnatifid with few segments, or lyrate with a large, ovate or elliptic entire or coarsely dentate terminal segment and small triangular to hastate basal ones; glabrous or sparsely pilose; nerves 5-6 on either side of the midrib; petiole shorter than the blade,

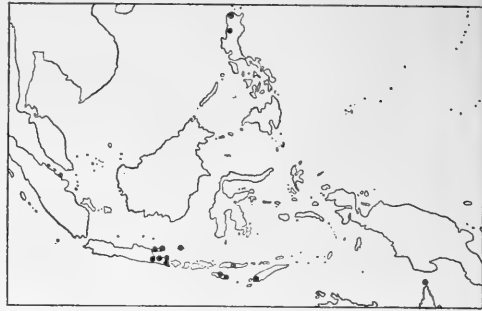


Fig. 39. *Ipomoea polymorpha* R. & SCH. Distribution in Malaysia. The species also occurs in NE. New Guinea: Morobe District.

½-3 cm, sparsely pilose. *Flowers* axillary, solitary. Peduncle and pedicel very short or absent. Bracts linear-filiform, ca 1 cm long, long hairy. *Sepals* with a distinct midrib, hairy, 8-10 mm long, long-acuminate; outer ones ovate-lanceolate, entire or with 1 or 2 teeth at the margin, inner ones lanceolate. *Corolla* tubular-funnel-shaped, ca 1¼ cm long, red-purple, darker inside, rarely white, glabrous. Stamens and style included; filaments hairy at the base. Ovary and style glabrous. *Capsule* globular, 4-6 mm high, shorter than the calyx, glabrous, straw-coloured, 2-celled, 4-valved. Seeds 4, ca 2½-3¼ mm long, with a mottled brownish or greyish black pubescence.

Distr. Abyssinia, ?India, Indo-China, and Formosa to NE. Australia, in Malaysia: E. Java, Madura, Lesser Sunda Islands (Sumba, Flores, Timor), Philippines (Luzon), NE. New Guinea & Thursday Island. Fig. 39.

Ecol. Grasslands, grassy waysides, fields, sandy plains, dunes, in the lower parts of the islands with a strong dry monsoon, on hard or stony soil, in sunny localities, from sea-level to ca 100 m.

Vern. *Camarin*, Iloko (Philippines).

## 2. Section *Pharbitis*

(CHOISY) GRISEB. Fl. Brit. W. Ind. Isl. (1864) 473; OOSTSTR. Blumea 3 (1940) 483, 495.—*Pharbitis* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 438.—*Ipomoea subg. Pharbitis* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 199.

Annual, or rarely perennial, high-twining, rarely small herbs. Stems mostly hispid or lanate, very rarely glabrous. *Leaves* cordate, entire, 3-lobed, or palmately 5-7-lobed, rarely oblong or lanceolate, hispid or villose, sometimes white-lanate beneath, very rarely glabrous. *Flowers* mostly showy. *Sepals* herbaceous, oblong, lanceolate or linear, often hirsute, very rarely glabrous. *Corolla* mostly reddish or purple, funnel-shaped or rarely tubular, subentire. Seeds glabrous, puberulent, or shortly arachnoid.

### 1. Subsection *Chorisanthae*

HALLIER f. Bot. Jahrb. 18 (1893) 135; OOSTSTR. Blumea 3 (1940) 484, 495.

Flowers axillary, solitary, or in lax axillary dichasia, rarely aggregate. Leaves

distinctly cordate, entire, or 3-lobed, or palmately 5-lobed, never oblong or lanceolate.

4. *Ipomoea purpurea* (L.) ROTH, Bot. Abh. (1787) 27; OOSTSTR. Blumea 3 (1940) 496.—*Convolvulus purpureus* LINNÉ, Sp. Pl. ed. 2, 1 (1762) 219.—*I. hispida* ZUCC. Cent. Obs. (1806) no 36.—*Pharbitis hispida* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 438.

Herbaceous annual. Stems twining, with short hairs mixed with longer retrorse bristles. *Leaves* broadly ovate or orbicular in outline, entire or 3-lobed, 4–15 by 2½–12 cm, cordate at the base with broadly rounded basal lobes, shortly acuminate at the apex; upper and lower surface with short bristly hairs; petiole 2–15 cm, retrorsely hirsute. *Inflorescences* axillary; peduncle shorter or longer than the petiole, with retrorse bristles, 3–18 cm, one- to few-flowered at the apex. Pedicels 8–15 mm, recurved in bud, afterwards erect, finally recurved again, in fruit up to 20 mm. Bracts linear or filiform, to 7 mm long. *Sepals* about equal in length, ca 10–15 mm, in fruit to 20 mm, three outer ones herbaceous or sepal 3 with a narrow scarious margin, oblong, slightly narrowed at the base, acute at the apex, with bristly, patent hairs in the basal portion, glabrous towards the apex; two inner ones herbaceous with narrow scarious margins, linear-oblong to linear, acute. *Corolla* funnel-shaped, 5–6 cm long, glabrous; limb inside purple-blue with reddish midpetaline bands, outside often paler; tube much paler to white. Stamens and style included; filaments at the base with long hairs. Ovary glabrous, 3-celled. *Capsule* globular, glabrous, 3-celled, with thin straw-coloured wall. Seeds 6 or less, glabrous or sparsely pilose at the hilum.

Distr. Native in America from New Mexico & Virginia as far S. as Argentina and Uruguay, in *Malaysia* occasionally cultivated in gardens for ornamental purposes, but showing no tendency to become naturalized.

Vern. Morning glory, E, dagschone, dagbloem, purperwinde, D.

5. *Ipomoea nil* (L.) ROTH, Cat. Bot. 1 (1797) 36; OOSTSTR. Blumea 3 (1940) 497.—*Convolvulus nil* LINNÉ, Sp. Pl. ed. 2, 1 (1762) 219.—*I. scabra* FORSK. Fl. Aeg.-Arab. (1775) 44.—*I. setosa* BL. Bijdr. (1825) 714.—*Pharbitis nil* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 439.—*I. trichocalyx* STEUD. Nom. ed. 2, 1 (1840) 819, non DON 1838.—*I. nil* ROTH var. *setosa* BOERL. Handl. Fl. Ned. Ind. 2 (1899) 511.

Herbaceous annual or perennial. Stems twining, or sometimes prostrate, retrorsely hirsute. *Leaves* broadly ovate to orbicular in outline, entire or 3-lobed, 4–14 by 3–12 cm, cordate at the base, acuminate at the apex; upper and lower surface with few to many more or less appressed hairs; petiole 3–16 cm, retrorsely hirsute. *Inflorescences* axillary; peduncle 2½–12 cm, hirsute like the stem, one- to several-flowered at the apex; flowers in a small umbellate cyme. Pedicels 5–10 mm, with

retrorse hairs. Bracts linear to filiform, 5–8 mm long. *Sepals* herbaceous, about equal in length, 17–25, afterwards to 28 mm long, patently hirsute especially in the basal portion; sometimes the bristly hairs are mixed with shorter and softer ones; outer sepals with a lanceolate, inner ones with a narrow-lanceolate base, all with a long and linear acum. *Corolla* funnel-shaped, ca 5–6 cm long, glabrous, pale blue or bright blue, paler without, afterwards red or reddish purple, rarely the corolla is white. Stamens and style included; base of filaments with curled hairs. Ovary glabrous. *Capsule* ovoid to globular, mucronate by the base of the style, ca 1 cm diam., glabrous, mostly 3-valved and 3-celled. Seeds ca 5 mm long, black, grey-puberulent.

Distr. Circumtropical, throughout *Malaysia*, but not yet found in Borneo.

Ecol. Waysides, hedges, thickets, grasslands, from sea-level to 1300 m; also cultivated in gardens for ornamental purposes. Flowers closing before noon.

Use. The seeds are said to be purgative.

Vern. *Areuj djotang bodas*, S, *teleng*, J, *bula-kán*, *kamokamotihan*, Tag.

Note. Several authors have wrongly considered the *Malaysian* specimens conspecific with the North American *Ipomoea hederacea* (L.) JACQ. See HALLIER f. Jahrb. Hamb. Wiss. Anst. 16, 1898, Beih. 3 (1899) 42; OOSTSTR. Blumea 3 (1940) 499.

var. *limbata* (LINDL.) BAILEY, Gentes Herb. 1, 3 (1923) 135.—*Pharbitis limbata* LINDL. J. Hort. Soc. 5 (1850) 33; mentioned by BOERLAGE, Handl. Fl. Ned. Ind. 2 (1899) 511 as *I. limbata*, is a cultivated variety with the corolla deep violet-purple edged with white.

6. *Ipomoea congesta* R.BR. Prod. (1810) 485; OOSTSTR. Blumea 3 (1940) 500.—?*Convolvulus indicus* BURM. Ind. Univ. Herb. Amb. 7 (1755) 6.—*Convolvulus acuminatus* VAHL, Symb. Bot. 3 (1794) 26.—*I. cathartica* POIR. in LAMK, Enc. Suppl. 4 (1816) 633.—*I. acuminata* R. & SCH. Syst. 4 (1819) 228, non RUIZ & PAV. 1799.—*I. amoena* BL. Bijdr. (1825) 718.—*I. acuminata* R. & SCH. var. *burckii* BOERL. Handl. Fl. Ned. Ind. 2 (1899) 511.—?*I. indica* MERR. Interpr. Rumph. Herb. Amb. (1917) 445.—Fig. 39 A.

Herbaceous. Stems twining or sometimes prostrate and then sometimes rooting at the nodes, more or less densely retrorsely pilose. *Leaves* broadly ovate to orbicular in outline, entire or 3-lobed, 5–17 by 3½–16 cm, cordate at the base, shortly or long-acuminate at the apex; lower surface often densely, upper surface less densely pilose with short, soft, appressed hairs, sometimes the lower surface sericeo-tomentose; petiole 2–18 cm long, retrorsely hairy. *Inflorescences* axillary; peduncle (1½)–4–20 cm, more or less densely and

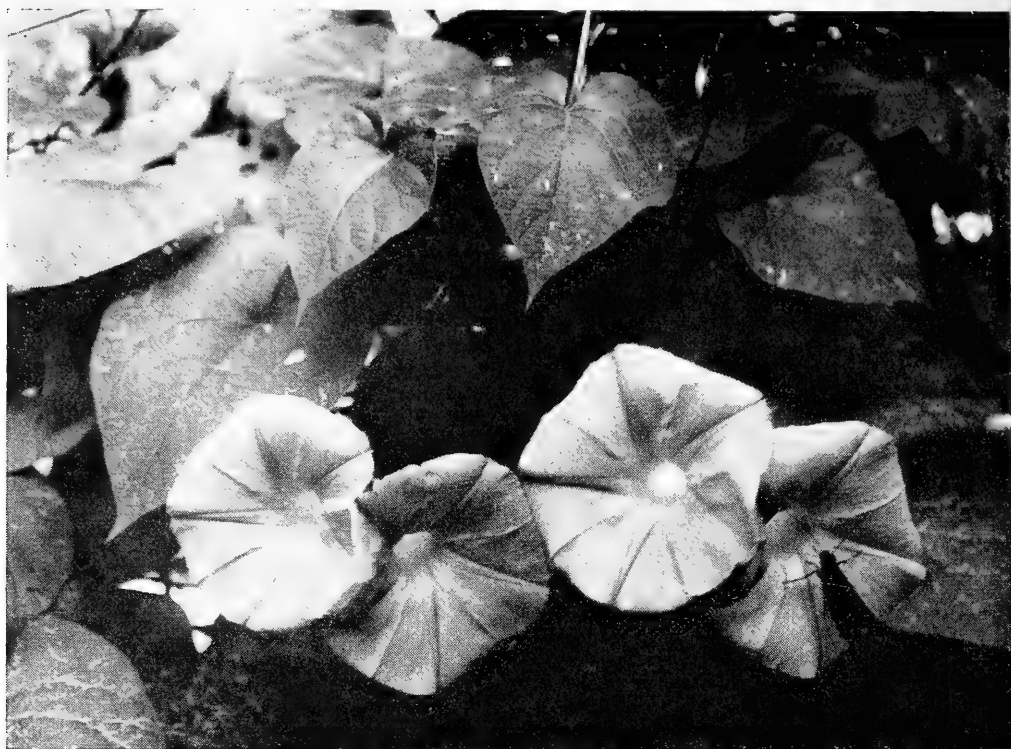


Fig. 39 A. *Ipomoea congesta* R.Br. Right flower with a honey-sucking Hesperid. Cultivated at Bogor, 1931.

retroscarsely pilose like the stem, few- to several-flowered at the apex. *Flowers* in a dense umbellate cyme with very short branches. Pedicels 2–5(–8) mm. Bracts linear to filiform, occasionally broader and foliaceous. *Sepals* herbaceous, about equal in length, 14–22 mm, especially near the base with rather soft, appressed hairs, or nearly glabrous, not with patent bristly hairs as in *I. nil*; outer sepals with a lanceolate to broadly lanceolate base, inner ones with a narrower base, all long and gradually linear-acuminate. *Corolla* funnel-shaped, 5–8 cm long, glabrous, bright blue or bluish purple, afterwards more reddish purple or red, the tube much paler to whitish. Stamens and style included; base of filaments with curled hairs. Ovary glabrous. *Capsule* not seen in Malaysian specimens.

*Distr.* Circumtropical, throughout *Malaysia*, but not yet collected in Borneo.

*Ecol.* Waste places, road-sides, thickets, hedges, edges of secondary forests, occasionally on sandy sea-shores; from sea-level to 1650 m; also cultivated in gardens for ornamental purposes (see note).

*Vern.* *Bungah*, Sumatra, *pitur*, Manado, *apukung'a*, Talaud, *lobokè ma dorooë*, Halmaheira, *bulakan*, Sulu.

*Note.* *Ipomoea leari* PAXT. Bot. Mag. 6 (1839)

267, which is sometimes found cultivated for ornamental purposes, is a very closely related species or only a variety of *I. congesta*. It has the leaves thickly clothed with a whitish pubescence beneath; the corolla is of a deep purplish blue colour, with lighter midpetaline bands.

7. *Ipomoea decaisnei* OOSTSTR. Blumea 3 (1940) 503.—*Pharbitis variifolia* DECAISNE, Nouv. Ann. Mus. Hist. Nat. Par. 3 (1834) 390, non *I. variifolia* MEISSN. 1869.

A herbaceous annual (DECAISNE). Stems twining, almost filiform, glabrous or sparsely pilose with long patent hairs. *Leaves* broadly ovate, ovate or triangular, (1½–)3–9 by (1–)1½–7 cm, cordate at the base with rounded basal lobes, shortly or long-acuminate at the apex with an acute or obtusish, mucronulate acumen; upper and lower surface sparsely or sometimes densely pilose; petiole shorter than the blade, (½–)2–4½ cm, with sparse patent hairs. *Inflorescences* axillary; peduncle mostly rather short, ½–4 cm, patently pilose, few-flowered at the apex; *flowers* in an umbellate cyme. Pedicels 5–9 mm, in fruit 10–17 mm. Bracts linear or filiform, the lower ones to 9 mm long, with sparse patent hairs. *Sepals* herbaceous, subequal, 8–15 mm long, linear, attenuate towards the acute apex, patently hairy in the lower

half, the hairs with thickened base, glabrous towards the top. *Corolla* funnel-shaped, ca 2–2½ cm long, glabrous, violet. Stamens and style included; filaments hairy at the base. Ovary glabrous. *Capsule* globular, mucronate by the style-base, with a thin straw-coloured pericarp, ca 7–8 mm high, 4-valved. Seeds 4–4½ mm long, black, finely puberulent, mottled brownish and greyish.

Distr. *Malaysia*: E. Java, Madura, SW. and SE. Celebes (Buton Isl.), Lesser Sunda Islands (Lombok, Sumbawa, Timor).

Ecol. Thickets, hedges, waysides, apparently restricted to regions subject to a pronounced dry period, from sea-level to 750 m.

Vern. *Kelawat wungu, gamet, J, daun tapahaik*, Timor.

## 2. Subsection *Cephalanthae*

(CHOISY) HALLIER f. Bot. Jahrb. 18 (1893) 131; OOSTSTR. *Blumea* 3 (1940) 484, 504.—*Ipomoea* sect. *Strophipomoea* § *Cephalanthae* CHOISY in DC. Prod. 9 (1845) 363.—*Ipomoea* sect. *Cephalanthae* BAKER & RENDLE, Fl. Trop. Afr. 4, 2 (1905) 131.—*Ipomoea* sect. *Involucratae* BAKER & RENDLE, l.c. 130.

Flowers in dense capitate, involucre, peduncled inflorescences; outer bracts mostly large.

8. *Ipomoea pes-tigridis* LINNÉ, Sp. Pl. (1753) 162; OOSTSTR. *Blumea* 3 (1940) 504.—*I. hepaticaeifolia* LINNÉ, l.c. 161.—Fig. 40.

Herbaceous annual. Stems twining, or sometimes prostrate, slender, 1½–3 m long, patently hairy with rigid hairs. *Leaves* orbicular or transversely elliptic in outline, 3–7½ by 2½–10 cm,

palately divided nearly to the base with (3–)5–7 (–9) segments; segments oblong to elliptic-oblong or elliptic, attenuate or slightly acuminate towards both ends, mostly rather densely hairy with appressed to patent hairs; petiole 1½–10 cm, hairy like the stem. *Inflorescences* axillary; peduncle 2–18 cm, hairy like the stem, with an involucre, cymose, few-flowered head at the apex. Outer bracts oblong to linear-oblong, 1½–3 cm, inner ones smaller. *Sepals* herbaceous, slightly unequal in length, 7–12 mm, lanceolate or the inner ones narrow-lanceolate, long-hairy. *Corolla* funnel-shaped, ca 3–4 cm long, white, the midpetaline bands sparsely hairy. Stamens and style included; filaments glabrous. Ovary glabrous. *Capsule* ovoid, ca 8 mm high, 1-celled, 4-valved. Seeds 4, sparsely grey-tomentose, 4 mm long.

Distr. East tropical Africa, Mascarene Islands, continental tropical Asia, throughout *Malaysia*.

Ecol. Grasslands, waste places, fields, thickets, occasionally in teak-forest, also on sandy soil near the sea; from sea-level to 1000 m.

Use. The leaves are used in Java and in the Philippines for poulticing sores (HEYNE; BROWN).

Vern. *Lau attan*, Djakarta, *djembutan, topong, kontolan, gamet, gametan, J, kak samangkakan*, Md, *bungku-kuale, bumbuhwale*, Gorontalo, *kahanga kurung*, Sumba, *samaka furu*, Ternate, *maka maka*, Tidore, *sajor patolla, patolla utang*, Banda, *waras fufulu*, Tenimber; Philippines: *bangbangau-ñg-buduan*, Ilóko, *malasandia, sala-sandia*, P. Bis.

9. *Ipomoea pileata* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 94; OOSTSTR. *Blumea* 3, (1940) 507.—? *Convolvulus trichocalyx* ZOLL. Nat. Ge-neesk. Arch. 2 (1845) 6.

Herbaceous annual. Stems twining, 1.2–1.8 m long, slender, retrorsely short-pilose. *Leaves* ovate or broadly ovate, 2–7 by 1½–5½ cm, broadly cordate at the base with rounded basal lobes, attenuate to slightly acuminate towards the apex, pilose, beneath sometimes more densely than above; nerves 4–6 on either side of the midrib; petiole thin, 1½–10 cm, pilose like the stem.



Fig. 40. *Ipomoea pes-tigridis* L. Branches with flowers and fruits, × 1/2.

*Inflorescences* axillary; peduncles 2–4½ cm, pilose like the stem; *flowers* in a few- to several-flowered dense head, enclosed by a large foliaceous boat-shaped bract, 2½–4 cm long, with 2 cusps; other bracts much smaller, oblong or elliptic, obtuse. *Sepals* herbaceous, 3 outer ones oblong-spathulate to oblong, obtuse, 10 mm long, 2 inner ones narrower, lanceolate with a long and slender point, 9 mm long, all long pilose along the margins, and outside and inside especially in the upper part. *Corolla* salver-shaped, ca 3 cm long, pink with darker centre, or violet; tube narrow, cylindrical, ca 2 cm long, glabrous except near the top, limb with sparsely pilose midpetaline bands. Stamens and style included; filaments inserted half-way the corolla-tube, glabrous, the base excepted.

Ovary glabrous. *Capsule* small, globose. Seeds glabrous or thinly pubescent.

*Distr.* Tropical E. Africa, Mascarene Islands, continental tropical Asia from India to China, Indo-China and Hainan, in *Malaysia*: Malay Peninsula (Perlis), Banka, Java, Borneo, and the Philippines (Culion).

*Ecol.* Dry open places, grassy waysides, fields, from sea-level to 400 m.

*Vern.* *Bissur hutang*, Banka.

*Note.* Several authors have considered this species as being conspecific with the African *I. involucreata* BEAUV. (See VAN OOSTSTR. *Blumea* 3, 1940, 509, note). BAKER & RENDLE, *Fl. Trop. Afr.* 4, 2 (1905) 150, 151, 152, have rightly distinguished them as two distinct species.

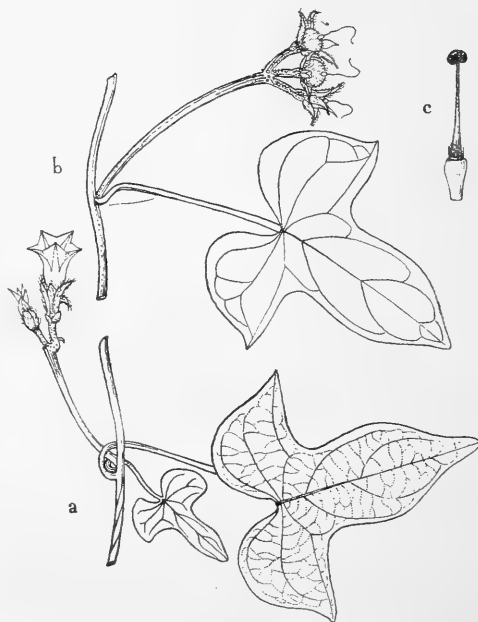
### 3. Section *Batatas*

(CHOISY) GRISEB. *Fl. Br. West Ind. Isl.* (1864) 468; OOSTSTR. *Blumea* 3 (1940) 484, 509.—*Batatas* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 434.—*Ipomoea* subg. *Batatas* CLARKE in HOOK. *f. Fl. Br. Ind.* 4 (1883) 201.—*Ipomoea* sect. *Leiocalyx* HALLIER *f. sensu* BAKER & RENDLE, *Fl. Trop. Afr.* 4, 2 (1905) 132, *p.p.*

*Leaves* petioled, distinctly cordate or pandurate or 3-lobed or palmately 5-lobed, glabrous, or appressed-hairy. *Flowers* mostly small, axillary, in long- or short-peduncled umbellate cymes, rarely solitary; flower-buds conical, often acute. *Sepals* subcoriaceous, often oblong or lanceolate, acute, with ciliate margins, further often glabrous, often attenuate from a stiff pale base into a herbaceous green, recurved acumen, rarely obtuse, or entirely glabrous. *Corolla* funnel-shaped, entire, pink or white, 1½–5 cm long, glabrous. Ovary often hirsute. Seeds glabrous.

10. *Ipomoea triloba* LINNÉ, *Sp. Pl.* (1753) 161; OOSTSTR. *Blumea* 3 (1940) 509.—*Convolvulus dentatus* BLANCO, *Fl. Filip.* ed. 1 (1837) 89, *non* VAHL 1794 (acc. to MERRILL).—*I. blancoi* CHOISY in DC. *Prod.* 9 (1845) 389.—**Fig. 41.**

Herb with twining or sometimes prostrate stems, 1–3 m long, glabrous or sparsely hairy, mainly at the nodes. *Leaves* broadly ovate to orbicular in outline, rarely narrower, 2½–8 by 2–7 cm, entire, coarsely dentate to more or less deeply 3-lobed, base cordate, basal lobes rounded or angular to lobed, upper and lower surface glabrous or sparsely pilose; petiole slender, 3–10(–18) cm, glabrous, or sometimes minutely tuberculate. *Inflorescences* axillary; peduncle shorter to longer than the petiole, 1–10(–12) cm, slightly thicker than this, glabrous, angular, minutely verrucose towards the apex, 1-flowered or cymosely few- to several-flowered; branches of the cyme very short, *flowers* aggregate. Pedicels more or less angular, minutely verrucose, glabrous, 2½–8 mm. Bracts minute, lanceolate-oblong. *Sepals* slightly unequal, 7–8(–10) mm long, the outer ones a little shorter, oblong to narrowly elliptic-oblong, obtuse or acutish, mucronulate, glabrous or sparsely hairy on the back, the margins always distinctly fimbriate; inner sepals somewhat broader, elliptic-oblong, acute, mucronulate, glabrous or sparsely hairy. *Corolla* funnel-shaped, ca 18–20 mm long, glabrous, pink or pale red-purple, sometimes with



**Fig. 41.** *Ipomoea triloba* L. a. Flowering branch,  $\times \frac{1}{2}$ , b. fruiting branch,  $\times \frac{1}{2}$ , c. pistil.

a darker centre, the limb with short obtuse, mucronulate lobes. Stamens included, filaments hairy at the base. Ovary hairy. *Capsule* subglobose, 5–6 mm high, apiculate by the base of the style, bristly hairy, 2-celled, 4-valved. Seeds 4 or less, 3½ mm long, glabrous.

Distr. Native of tropical America, now a circumtropical weed; throughout *Malaysia*.

Ecol. Grasslands, thickets, hedges, waste places, waysides, fields, also in savannah-forests and occasionally on sandy sea-shores, from sea-level to 750 m. Flowers closing before noon.

Vern. *Gégasing*, Singapore; in the Philippines: *aurora*, Spanish and Tag., *bang-ba-ñaga*, *kamkamôte*, *koskustipa*, *kupit-kupit*, Iloko, *halobagbug*, Tag., *muti-muti*, C. Bis., *sagikat*, Bag.

11. *Ipomoea trifida* (H.B.K.) G. DON, Gen. Syst. 4 (1838) 280.—*Convolvulus trifidus* H.B.K. Nov. Gen. Sp. 3 (1819) 107.—*I. commutata* (non R. & Sch.) OOSTSTR. *Blumea* 3 (1940) 512.

Much resembling the preceding species. Mainly differing in the short-pilose stems, petioles, leaf-blades, peduncles and pedicels, the thinner peduncles, the longer branches of the cymose inflorescences with less aggregate flowers, the paler, in dry specimens straw-coloured calyces with more densely pilose sepals, the margins of which bear less stiff hairs. Moreover the sepals often have a longer, needle-shaped mucro, whilst the outer ones are often distinctly shorter than the inner. *Corolla* mostly longer than in *I. triloba*, to 3 cm long, red-purple with a darker centre.

Distr. Native of Tropical America; in *Malaysia* sometimes as a garden-escape in Java.

Ecol. Occasionally cultivated in gardens and run wild in thickets and hedges up to 300 m.

Vern. *Djëndjénang*, J.

Note. The Javan plants almost match South American specimens in the Rijksherbarium, Leyden, identified by HALLIER as *I. trifida*. As appears from his notes HALLIER saw the type of *Convolvulus trifidus* H.B.K. from Venezuela in the Berlin Herbarium. The leaves of *I. trifida* have been described as 3-lobed; those of the Javan plants and of the above-mentioned specimens from South America are entire.

12. *Ipomoea tiliacea* (WILLD.) CHOISY in DC. Prod. 9 (1845) 375; OOSTSTR. *Blumea* 5 (1942) 233.—*Convolvulus tiliaceus* WILLD. Enum. 1 (1809) 203.—*Convolvulus fastigiatus* ROXB. [Hort. Beng. (1814) 13, *nom. nud.*] Fl. Ind. ed. CAREY & WALL. 2 (1824) 48.—*I. fastigiata* SWEET, Hort. Brit. ed. 1 (1826) 288.

Stems twining, slender, several metres long, glabrous or hirsute, lignescent. *Leaves* ovate, 5–15 by 3–10 cm, cordate at the base, acuminate, with an acute or obtusish mucronulate acumen, mostly entire, glabrous or appressed-pilose; petiole slender, 3–7 cm. *Inflorescences* axillary; peduncles solitary or in pairs, as long as, or often longer than the petiole, 4–15 cm, cymosely few- to several-flowered. Pedicels 5–12 mm. Bracts minute, narrow-lanceolate. *Sepals* glabrous or sparsely

fimbriate at the margins, nearly equal in length or the outer ones shorter; outer sepals oblong or ovate-lanceolate, acute, mucronulate, 5–10 mm long, inner ones elliptic, acutish or obtuse, often with a less distinct mucro, to 10 mm long. *Corolla* funnel-shaped, ca 4–6 cm long, glabrous, pink or purple, often with a darker centre, or rarely white. Stamens and style included; filaments sparsely pubescent nearly to the apex. Ovary glabrous. *Capsule* globular, 2-celled, 4-valved. Seeds 4, glabrous or pilose along the edges.

Distr. Tropical America, West tropical Africa (Cameroons, I. do Principe); in *Malaysia*: North Moluccas (Karakelong), NW. New Guinea.

Ecol. River-banks, clearings in secondary forests, up to ca 100 m.

Vern. *Bariwuàn'a*, Talaud.

13. *Ipomoea batatas* (L.) LAMK, Tabl. Enc. 1 (1791) 465; OOSTSTR. *Blumea* 3 (1940) 512.—*Convolvulus batatas* LINNÉ, Sp. Pl. (1753) 154.—*Convolvulus edulis* THUNB. Fl. Jap. (1784) 84.—*Batatas edulis* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 435.

Herb with subterranean fusiform or elongate tubers. Stems prostrate or ascending, or occasionally twining, 1–5 m long, much branched, more or less angular, or terete, rooting at the nodes, glabrous or hairy, green or tinged with purple. *Leaves* broadly ovate to orbicular in outline, 4–14 by 4–11 cm, entire, angular, or more or less deeply palmately 3–5(–7)-lobed, the lobes from broadly ovate to linear-oblong; base of leaf broadly cordate to truncate; upper and lower leaf-surfaces glabrous or sparsely hairy; petiole 4–20 cm. *Inflorescences* axillary; peduncle stout, angular, glabrous or hairy like the stem, shorter to much longer than the petiole, 3–18 cm, cymosely 1- to few- or several-flowered. Pedicels 3–12 mm. Bracts acute, 2–3 mm long, caducous. *Sepals* equal in length or the inner ones longer; outer ones oblong or elliptic-oblong, 7–8 mm long, inner ones elliptic-oblong to ovate-oblong, to 9–12 mm long, all acute or acutish, distinctly mucronulate, wholly glabrous or pilose on the back and fimbriate. *Corolla* campanulate to funnel-shaped, gradually attenuate towards the base, ca 3–4½ cm long, glabrous, pale violet. Stamens and style included; filaments glabrous, the hairy base excepted. Ovary hairy or sometimes glabrous. *Capsule* ovoid, 4- or less-celled, rare, or absent in Malaysian specimens. Seeds glabrous.

Distr. Cultivated throughout the tropical and subtropical regions of both hemispheres.

Ecol. Cultivated throughout *Malaysia*, and occasionally wild as a relic of cultivation; at low and medium altitudes; in Java sometimes up to 2200 m (KOORDERS).

Uses. Cultivated for its edible tubers. The young leaves are used as a vegetable; young shoots are eaten as a salad, and are also used for poulticing.

Vern. *Kěladi*, *kěladek*, *ubi kěladi*, Mal. Pen., *gadong*, *piék*, *képileu*, N. Sum., *ubi djawa*, *ubi tjina*, Sum. E. Coast, *katélo*, *ubi djaloh*, *u. katélo*, *u. pélo*, Minangk., *sétilo*, Lampongs, *kělèdek*, *ketéla*, *ketéla rambat*, *téla*, J, *huwi boèd*, *huwi*

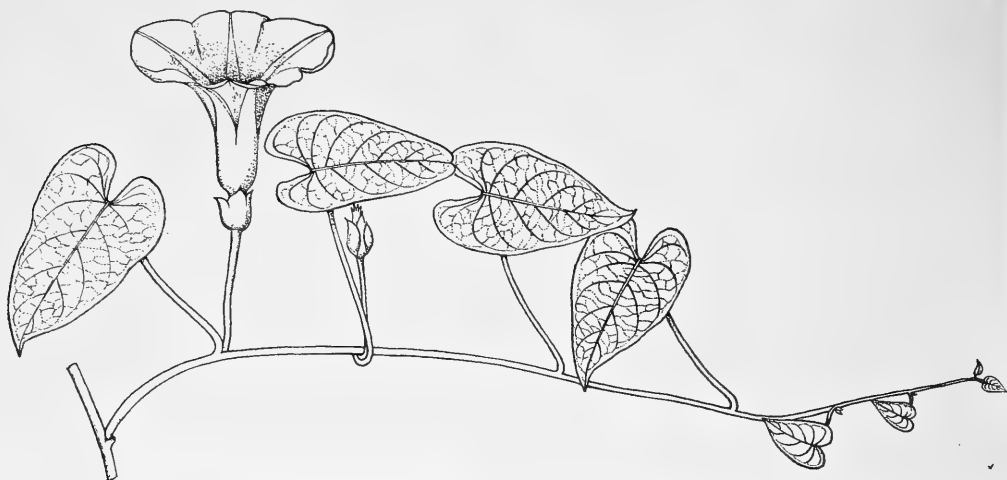


Fig. 42. *Ipomoea gracilis* R.Br. Flowering branch,  $\times 2/3$ .

*mantang*, S, *sabhrang*, s. *longgha*, Md, *kēsèla*, Bali, *katabang*, Sumbawa, *loli*, Timor, *sané*, Wetar, *watata*, *batata*, *bagé*, *lamé djawa*, l. *kamu-mu*, l. *kandora*, Celebes, *urlau*, *uru*, Aru, *en mav*, Kei, *ihim basala*, *uwi kastèla*, *kastèra*, *kaitela*, *asitèla*, Ceram, *patatas*, *paära tukalé*, Ambon, *mangat*, Buru, *daso*, Halmahera, *ima*, Ternate, *daso*, Tidore, *ranso*, Noef, *sabakruwa*, *ningoi*, Neth. N. Guinea; Philippines: *camôte*, all dialects, *lapni*, Ifugao, *pangbigagun*, Sulu, *tigsi*, Bis., *tugi*, Bont.; *sweet potato*, E, *bataat*, D. See for more local names DE CLERCQ-PULLE, Nieuw Plantk. Woordenb. ed. 2 (1927) 125, HEYNE, Nutt. Pl. Ned. Ind. (1927) 1301, VAN OOSTSTROOM, l.c.

Note. A large number of varieties is found in cultivation, mainly distinguished on account of the leaf-shape and the size, form and colour of the tubers. The tubers may be red, purple, orange, pale yellow, or white.

Caterpillars of *Herse convolvuli* L. feed on the leaves of this species.

**14. *Ipomoea gracilis* R.Br.** Prod. (1810) 484; OOSTSTR. *Blumea* 3 (1940) 516.—*Convolvulus denticulatus* DESR. in LAMK, Enc. 3 (1789) 540.—*I. littoralis* BL. Bijdr. (1825) 713.—*I. denticulata* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 467, non R.Br. 1810.—*Calystegia affinis* (non ENDL.) SCHUM. Bot. Jahrb. 9 (1887) 216.—**Fig. 42–43.**

A glabrous or sometimes sparsely hairy littoral plant. Stems prostrate and rooting (always?), or twining, thin, slender, herbaceous, or becoming woody with age. Leaves membranaceous or often thicker, broadly ovate to oblong in outline, occasionally orbicular to kidney-shaped, variable in size, 1–10 by 1–7½ cm; margin entire or slightly undulate to angular, or more or less deeply 3-lobed; apex acute, obtusish, obtuse or retuse, mucronulate; base cordate, basal lobes rounded, or occa-

sionally lobed; upper and lower surface of leaf-blade glabrous or nearly so; petiole thin, ½–7 cm. Inflorescences axillary; peduncles mostly short, 1–3(–9) cm, glabrous, one- to few-flowered. Pedicels mostly longer than the calyx, 10–25(–40) mm long, glabrous. Bracts minute, narrow, 1–2 mm long, caducous. Outer sepals shorter than the inner ones, oblong-elliptic or elliptic, acutish or obtusish, 6–10 mm long, inner ones elliptic to orbicular, 8–12 mm, all mucronulate with the mucro at the top or somewhat lower, all glabrous and concave; outer sepals thinly coriaceous, inner ones thinner with membranous margins. Corolla funnel-shaped, 3–4½ cm long, with the rather narrow tube gradually narrowed towards the base, glabrous, pink or pink purple, often darker near the base inside. Stamens and style included; filaments glabrous in the upper, and hairy in the lower half. Ovary glabrous. Capsule depressed-globose, crowned by the style-base, ca 9 mm diam., 2-celled. Seeds 4, glabrous, black, ca 3½–4 mm long.

Distr. Coasts of the Indian and Pacific Ocean: Madagascar and adjacent islands, India, Ceylon, Indo-China, throughout *Malaysia*, eastwards to N. Australia and the Pacific Islands; according to HALLIER f. also in Mexico & West Indies.

Ecol. On sandy beaches and in thickets near the sea-shore, occasionally covering large trees; from sea-level to ca 15 m.

Use. The species is useful as a sand-binder.

Vern. *Kangkong*, *tapak kuda kechik*, Mal. Pen., *akar hitang*, Palembang, *kangkong laut*, Banka; Minahasa: *sejawan salojon*, *siahabu salojen*, Ponosakan, *wanaring pante*, Tombulu; *meo bot*, Sula, *lobokè*, *lobokè ma loha*, Halmahera, *sajor petu*, Buru, *barwuan'a*, Talaud, *tjuf*, Sorong, *gamielke*, S. Neth. N. Guinea; Philippines: *bulakán*, Tag., *ditadit*, Iv., *koskusipa*, Iloko, *malakamôte*, Ibanág, *panggi-panggi*, Sulu.





Fig. 43. *Ipomoea gracilis* R.Br. in a bay on the beach of the eastern part of the Island of Krakatao twining round trees of *Casuarina equisetifolia* L. which appear like elongate cocoons (DOCTERS VAN LEEUWEN).

#### 4. Section *Leiocalyx*

HALLIER f. Bot. Jahrb. 18 (1893) 139; OOSTSTR. Blumea 3 (1940) 484; l.c. 519, p.p.—*Ipomoea* sect. *Leiocalyx* subsect. *Eu-Leiocalyx* OOSTSTR. l.c. 519.

Plants mostly glabrous, rarely with hairy stems, more rarely with hairy leaves or sepals. *Leaves* mostly petioled, very variable in form. *Flowers* peduncled, axillary, solitary or in subumbellate dichasia. *Sepals* variable, mostly oblong or lanceolate, often verrucose or cristate on the back. *Corolla* mostly red or purple, rarely white or yellow, glabrous, or rarely farinose or pubescent outside, mostly subentire. Seeds mostly glabrous, rarely velutinous or with bearded edges.

15. *Ipomoea obscura* (L.) KER-GAWL. Bot. Reg. 3 (1817) t. 239; OOSTSTR. Blumea 3 (1940) 519.—*Convolvulus obscurus* LINNÉ, Sp. Pl. ed. 2 (1762) 220.—*I. solanifolia* (non L.) BURM. f. Fl. Ind. (1768) 49.—*I. insuavis* BL. Cat.'s Lands Pl.-tuin (1823) 50.—Fig. 44.

Stems twining or prostrate, 1–2 m long, thin and slender, glabrous or patently hairy, sometimes almost lanate, the older parts lignescent. *Leaves* ovate to orbicular, or almost kidney-shaped, 2–10 by 2–9 cm; margin entire or slightly undulate, base cordate with rounded basal lobes; apex attenuate or acuminate with acute to obtuse, mucronulate top; glabrous or sparsely pilose on both sides with short, appressed hairs, or only fimbriate along the margins; petiole long, slender, up to 9 cm, glabrous or sparsely hairy. *Inflorescences* axillary; peduncles thin, almost filiform, 1–14 cm,

glabrous or sparsely pilose, one- to few-flowered. Pedicels much longer than the calyx, ca 1–2 cm, minutely verrucose, glabrous or very sparsely hairy, thickened towards the top in fruit. Bracts minute, narrow, acute, 1–2 mm long. *Sepals* subequal or the two outer ones slightly shorter, acutish, mucronulate, 3–4 mm long, glabrous or sometimes pubescent; outer sepals ovate, with narrow, white margins, the middle portion thicker, minutely verrucose; inner ones broadly ovate, thinner; sepals often reflexed in fruit. *Corolla* funnel-shaped, ca 2–2½ cm long, white or pale yellow with darker midpetaline bands, and with a dark purple centre. Stamens and style included; filaments very unequal in length, hairy at the base. Ovary glabrous. *Capsules* on reflexed pedicels, broadly ovoid, crowned by the style-base, 7–8(–9) mm high, straw-coloured, 2-celled, 4-



valved. Seeds 4, black, finely grey-puberulent, *ca* 4-4½(-5) mm long.

Distr. East tropical Africa, Mascarene Islands, tropical Asia, throughout *Malaysia* to N. Australia and Fiji.

Ecol. Grasslands, thickets, hedges, thin forests, waysides, waste ground, occasionally on sandy soil near the sea, from sea-level to 1300 m.

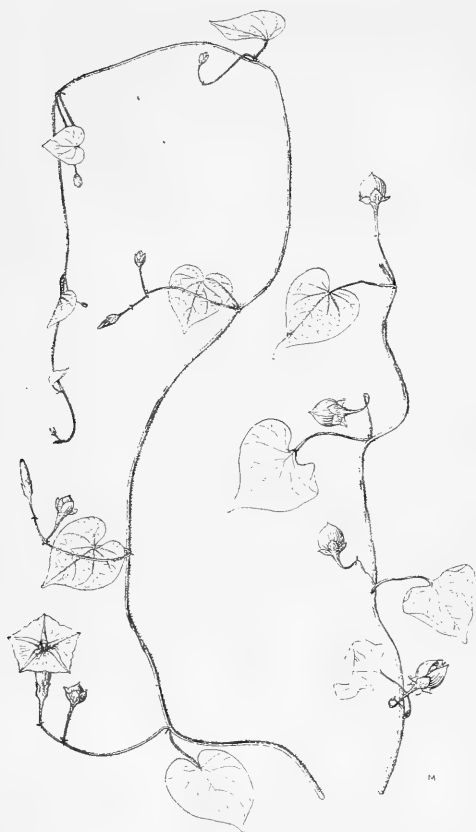


Fig. 44. *Ipomoea obscura* (L.) KER-GAWL.  
Flowering and fruiting branch,  $\times \frac{1}{2}$ .

Uses. The leaves, together with those of *Argyrea mollis*, are used against sores (HEYNE).

Vern. *Ki papësan*, S, *indjën-indjënan*, *malingan*, *tingkil*, J, *kaloh bibi*, Celebes; Philippines: *kuskusipa*, *bang-baṅgau*, Iloko, *panggi-panggi*, Sulu; for more local names see *Blumea* 3 (1940) 523.

16. *Ipomoea ochroleuca* SPANOGHE, *Linnaea* 15 (1841) 340 ('*ochroleuca*'); MIQ. *Fl. Ind. Bat.* 2 (1857) 614 ('*ochrolacea*'); OOSTSTR. *Blumea* 3 (1940) 523 ('*ochroleuca*').

Stems twining, thin, slender, glabrous or very sparsely, shortly and patently pilose; old stems with yellow, lacerate bark. *Leaves* ovate to broadly

ovate, 3½-8 by 2½-7 cm, cordate at the base with rounded lobes, shortly to long-acuminate at the apex, with acute or obtusish mucronulate point; mostly glabrous on both sides, the margins sometimes shortly fimbriate; petiole thin, 1-4 cm. *Inflorescences* axillary, peduncles thin, 3½-5 cm, glabrous or with very short patent hairs, one- to several-flowered, cymosely branched. Pedicels much longer than the calyx, 1½-3 cm, smooth, glabrous or hairy like the peduncle, thickened towards the apex in fruit. Bracts minute, oblong or triangular. *Sepals* equal in length, 5-6½ mm long, oblong to ovate-oblong, with attenuate, broadly rounded to truncate, slightly emarginate, mucronulate apex, glabrous; outer sepals with thick centre and thin, pale margins, inner ones thinner. *Corolla* widely funnel-shaped, *ca* 4 cm long, sulphur-yellow, glabrous, the pubescent apical parts of the midpetaline bands excepted. Stamens and style included; filaments unequal in length, hairy at the base. Ovary glabrous. *Capsules* on reflexed pedicels, broadly ovoid, crowned by the style-base, 10-11 mm high, straw-coloured, 2-celled, 4-valved, at the base with the reflexed sepals. Seeds 4, black, shortly brownish tomentose, *ca* 6 mm long.

Distr. *Malaysia*: Lesser Sunda Islands (Timor).

Ecol. On rocks near the sea; according to Mrs WALSH restricted to that habitat.

17. *Ipomoea stibaropoda* OOSTSTR. *Blumea* 3 (1940) 524.

Stems herbaceous, twining, slender, glabrous or sparsely pilose. *Leaves* broadly ovate to orbicular, 3½-6 by 3-6 cm, deeply cordate at the base, with rounded lobes, shortly acuminate at the apex, glabrous on both sides but shortly pilose near the entire, fimbriate margins; petiole 2-2½ cm, glabrous or sparsely hairy near the base. *Inflorescences* axillary; peduncles short, ½-1½ cm, terete, glabrous or sparsely pilose, 1-2-flowered. Pedicels much longer than the calyx, thick, glabrous, 15-18 mm long, at first erect, in fruit turned down, thickened, and up to 20-28 mm. *Sepals* equal in length, 5-6 mm long, rather thick, glabrous, mucronulate, outer ones ovate-oblong, acutish, with very narrow scarious margin, inner ones broader, to orbicular, rounded at the apex, with broader scarious margin. *Corolla* funnel-shaped, *ca* 4½ cm long, yellow. Stamens exserted; filaments shortly pilose at the base. Ovary glabrous. Young *capsule* ovoid, mucronate, glabrous.

Distr. *Malaysia*: S. Celebes (Salajar Islands).

Ecol. The only specimen known was found on limestone rocks.

18. *Ipomoea maxima* (L. f.) DON ex SWEET, Hort. Brit. ed. 2 (1830) 372; OOSTSTR. *Blumea* 3 (1940) 525.—? *I. sagittaeifolia* BURM. f. *Fl. Ind.* (1768) 50, t. 18, f. 2.—*Convolvulus maximus* LINNÉ f. Suppl. (1781) 137.—*I. sepiaria* KOEN. ex ROXB. *Fl. Ind.* ed. CAREY & WALL. 2 (1824) 90.—*I. verrucosa* BL. Bijdr. (1825) 718.—? *Quamoclit sagittaeifolia* CHOISY in DC. Prod. 9 (1845) 335; MERR. Philip. J. Sc. 19 (1921) 375.—*I. subtrilobans* MIQ. *Fl. Ind. Bat.* 2 (1857) 615.—Fig. 45-46.

A herbaceous perennial. Stems few to several from a stout pendicular root, twining or prostrate, 1-2½ m long, patently hirsute to glabrous. *Leaves* broadly ovate, orbicular or kidney-shaped, (1-2)2½-6 by (1-2)5 cm, mostly deeply cordate at the base, or sometimes slightly cordate to truncate with rounded or rarely angular basal lobes, attenuate towards the apex, or more or less abruptly acuminate with obtuse or acutish mucronulate acumen; the surfaces glabrous but with minute hairs along the margins above, often with purple margin or with purple spots, the margin entire or slightly angular; petiole often shorter than the blade, 1-3 cm, glabrous, with some minute hairs, or minutely verrucose. *Inflorescences* axillary; peduncle thick, often applanate, minutely verrucose towards the top, 1½-12 cm; few- to several-flowered in an umbellate cyme. Pedicels verruculose, ¾-1 cm. Bracts minute, persistent. *Sepals* equal in length or the interior ones slightly longer, 4-6 mm, glabrous, elliptic-oblong, obtuse, mucronulate, the minute mucro somewhat below the apex; outer sepals verruculose, coriaceous with thinner margins

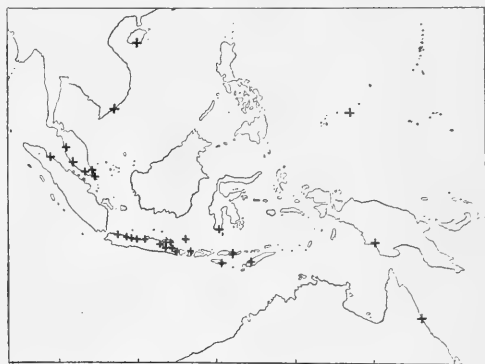


Fig. 46. *Ipomoea maxima* (L. f.) DON ex SWEET. Distribution in Malaysia.

*Corolla* about salver-shaped, pale lilac, pink, or nearly white, with a purple centre, 2-3 cm long, the limb 1¼-2½ cm diam. with shortly apiculate lobes. Stamens and style included; filaments glabrous, except the dilated base. Ovary glabrous. *Capsule* depressed-globular, ca 6-7 mm high, glabrous, 2-celled, 4-valved. Seeds 4, covered with a dense, very short, pale greyish or white tomentum, and often with some longer arachnoid hairs along the edges.

*Distr.* Tropical Asia, from India and Ceylon, Indo-China, Hainan, Formosa, Siam to Queensland; *Malaysia*: Sumatra (E. Coast), Malay Peninsula, Java, SW. Celebes, the Lesser Sunda Islands (Lombok, Sumba, Flores, Timor), and Neth. S. New Guinea (Merauke). Fig. 46.

*Ecol.* In moist, often somewhat saltish localities, near salines, on beaches, but also in moist grasslands, in fields, thickets, hedges, waste grounds and along waysides, from sea-level to 50 m. In Malaysia not found on the beaches bordering the Indian Ocean, but apparently almost confined to the clays of muddy seas.

*Vern.* *Akar kangkong bulu*, M, *tjemplingan*, J.

*Notes.* Some authors (see Blumea 3, 1940, 528, note 1) consider this to be conspecific with *I. sagittaeifolia* BURM. f., the type of which is unfortunately not to be found at Geneva. If they are right, BURMAN's name has priority.

A specimen from Timor (leg. Mrs WALSH, in Herb. Bog. and Herb. Mus. Brit.) has the leaves ovate-oblong with a sagittate base.

19. *Ipomoea aquatica* FORSK. Fl. Aeg.-Arab. (1775) 44; OOSTSTR. Blumea 3 (1940) 528.—*Convolvulus repens* VAHL, Symb. Bot. 1 (1790) 17, non LINNÉ 1753.—*I. reptans* POIR. in LAMK, Enc. Suppl. 3 (1814) 460, non *Convolvulus reptans* LINNÉ 1753.—*I. repens* ROTH, Nov. Pl. Sp. (1821) 110, *quoad* *descript.*, non *Convolvulus repens* LINNÉ 1753, nec *I. repens* LAMK, 1791; Bl. Bijdr. (1825) 713.—? *Convolvulus rostratus* ZIPP. Linnaea 15 (1841) 339, *pro syn.*—*I. subdentata* MIQ. Fl. Ind. Bat. 2 (1857) 614.—Fig. 47, 47 A, 48.

Herbaceous, perennial or sometimes annual



Fig. 45. *Ipomoea maxima* (L. f.) DON ex SWEET. Flowering branch, nat. size.



Fig. 47. *Ipomoea aquatica* FORSK. in gregarious development among lowland forest dying off on account of flooding in the ever-changing delta of the Djenemaëdja River, S. of Palopo, SW. Celebes.

(see notes). Stems mostly thick, hollow or spongy, rooting at the nodes, up to 2 or 3 m, trailing on moist soil or mud, or floating on water, occasionally thinner, trailing or twining; glabrous or hairy at the nodes. *Leaves* glabrous, variable in shape and size, even on the same plant, ovate, triangular, ovate-oblong, lanceolate or linear, 3–15 by 1–9 cm, truncate, cordate to sagittate or hastate at the base, with rounded or acutish to acute, entire or dentate basal lobes, acute or obtuse to retuse and mucronulate at the apex; leaf-margin above the basal lobes entire or coarsely dentate; petiole 3–20 cm, glabrous. *Inflorescences* axillary; peduncle 1–12 cm, glabrous, cymosely one- to few-flowered. Pedicels longer than the calyx, 2–6½ cm, glabrous. Bracts minute, narrow, acute. *Sepals* equal in length or the outer ones a little shorter, glabrous, with thin pale margins; outer ones ovate-oblong, obtuse, minutely mucronate or blunt, 7–8 mm long, inner ones ovate-elliptic, minutely mucronate, ca 8 mm long. *Corolla* funnel-shaped, (2½–)3–5 cm long, glabrous, pink or pale lilac, often with a purple centre, rarely entirely white. Stamens and style included; filaments hairy at the base. Ovary glabrous. *Capsule* ovoid to globose, ca 8–10 mm high, glabrous. Seeds 4 or less, densely greyish pubescent or sometimes glabrous.

Distr. Circumtropical, throughout Malaysia.

Ecol. In moist, marshy or inundated localities, in shallow pools, ditches, wet rice-fields, forming

dense masses; also along waysides, wild and cultivated, from sea-level to 1000 m. The species is easily propagated by cuttings.



Fig. 47A. *Ipomoea aquatica* FORSK. on a dense submerged growth of *Hydrilla verticillata* PRESL in the Lake of Lamongan, E. Java (RUTTNER).

Uses. An excellent palatable vegetable, especially the young shoots and leaves. Also used as 'fish-food' and in medicine. In the Malay Peninsula it is very general to feed it to pigs (BURKILL; HEYNE).



Fig. 48. *Ipomoea aquatica* FORSK. a. Flowering branch,  $\times \frac{1}{2}$ , b. part of thick, hollow, floating stem,  $\times \frac{1}{2}$ .

Vern. *Kangkung*, *kankong* in many languages. *Kangkung darat*, *kangkong paya*, Mal. Pen., *walai kērai*, *vellai kērai*, Tamil, *rumpun*, Atjeh, *kalajau*, *lalidih*, *kangkuēng*, Minangk., *kangkung*, *kangkung ajēr*, M, *kangkong*, Md, *lara*, *kangko*, *sajoha*, *sēriokang*, *sajor*, *ponangoi*, *kanto*, *tatanggo*, *tanggo*, *naniri*, *laré*, Celebes, *pangpung*, Bali, *nggango dano*, *ango dano*, *kako dano*, Roti, *kingkoi*, *kongkia*, *kangko*, Ceram, *utangko*, Buru, *beehob*, Marind., *takako*, *kako*, Halmahera, *kangko*, Tidore; Philippines: *balānggōg*, *galatgat*, Iloko, *kangkung*, *tankūng*, Sulu, *kangkóng*, Bik., Tag., Pamp., *tangkóng*, Iloko, Kuyonon, Bis.. For more local names see Blumea 3 (1940) 531.

Notes. According to BACKER, the species is perennial, or sometimes, in unfavourable localities, annual. There is a form in cultivation growing in dry places and another one growing in water;

in the Malay Peninsula they are distinguished as *kangkung darat* and *kangkong paya*, the former are grown in beds, the latter in ponds. OCHSE & BAKHUIZEN VAN DEN BRINK mention two forms, viz: *kangkung biasa*, S, with dark green leaves and stems, and lilac flowers, and *kangkung nagri*, S, with yellow-green leaves, yellowish stems, and white flowers.

HOCHREUTNER (Candollea 5, 1934, 186) states that a specimen preserved at Geneva, is the type of *I. sagittaeifolia* BURM. f.. This specimen is *I. aquatica* FORSK.. It is not the type of *I. sagittaeifolia* BURM. f. as the specimen does not match BURMAN's picture and description and, moreover, the sheet carries only HOUTTUYN's handwriting.

**20. *Ipomoea pes-caprae* (L.) SWEET, Hort. Suburb. Londin. (1818) 35; OOSTSTR. Blumea 3 (1940) 532.**—*Convolvulus pes-caprae* LINNÉ, Sp. Pl. (1753) 159.—*Convolvulus maritimus* DESR. in LAMK, Enc. Bot. 3 (1789) 550.—*I. maritima* R.BR. Prod. (1810) 486.—Fig. 49–50.

#### KEY TO THE SUBSPECIES

1. Leaves deeply 2-lobed, with rounded lobes; leaf-base cuneate to attenuate into the petiole. Outer sepals ca 9 mm long, inner ones ca 13 mm. Corolla ca 6½ cm long. *ssp. pes-caprae*
1. Leaves emarginate or sometimes truncate at the apex; truncate, rounded, shortly attenuate to subcuneate or slightly cordate at the base. Outer sepals 5–8, inner ones 7–11 mm long. Corolla 3–5 cm long. *ssp. brasiliensis*

*ssp. brasiliensis* (L.) OOSTSTR. Blumea 3 (1940) 533.—*Convolvulus brasiliensis* LINNÉ, Sp. Pl. (1753) 159.—*Convolvulus bilobatus* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 73.—*I. pes-caprae* (L.) SWEET var. *emarginata* HALLIER f. Bull. Soc. Roy. Bot. Belg. 37 (1898) 98.—Fig. 49–50.

Perennial, with a thick taproot. Stems long-trailing and rooting at the nodes, or occasionally twining, 5–30 m long, terete, angular, or flattened, glabrous, containing a milky juice. *Leaves* often secund, ovate, obovate, elliptic, orbicular, or transverse-elliptic to kidney-shaped, or quadrangular to oblong, 3–10 by 3–10½ cm, truncate, rounded, shortly attenuate to subcuneate or slightly cordate at the base, emarginate or sometimes truncate at the apex, mucronulate, rather thick and firm, glabrous; midrib below with two glands at the base of the blade; lateral nerves 8–10 on either side of the midrib; petiole up to 12(–17) cm, glabrous. *Inflorescences* axillary, secund; peduncles 3–16 cm, stout, angular or flattened, glabrous, cymosely one- to several-flowered. Pedicels longer than the calyx, glabrous, 12–30(–45), in fruit up to 45(–70) mm. Bracts small, ovate-lanceolate, 3–3½ mm long, caducous. *Sepals* subequal or the outer ones slightly shorter; outer sepals ovate to elliptic or broadly elliptic, 5–8 mm long, distinctly 3–5-nerved; inner ones broader, to orbicular and concave, 7–11 mm long, all obtuse and mucronulate,



Fig. 49. *Ipomoea pes-caprae* (L.) SWEET ssp. *brasiliensis* (L.) OOSTSTR. On the beach of the Island of Leiden, Bay of Djakarta (DOCTERS VAN LEEUWEN).

glabrous, subcoriaceous. *Corolla* funnel-shaped, 3–5 cm long, glabrous, pink, reddish purple or violet, darker inside at the base, rarely entirely white. Stamens and style included; filaments hairy at the base. Ovary glabrous. *Capsule* globular to depressed-globular, ca 12–17 mm high, glabrous, 2-celled, 4-valved. Seeds 4, black, densely brownish tomentose, 6–10 mm long.

*Distr.* Circumtropical, the common subspecies throughout *Malaysia*.

*Ecol.* On and immediately behind sandy seashores, occasionally in the interior, along waysides, ditches and canals, from sea-level up to 600 m.

*Uses.* The seeds are said to be a good remedy for stomach-ache and cramp. In E. Malaysia the leaves are made into poultices, which are used to ripen boils and applied to swellings, wounds, ulcers, etc. The juice of the stems is used in the Island of Nusa Kembangan (S. Java) as a medicine against bites and stings of fishes. The species may be useful as a sand-binder (BURKILL; HEYNE).

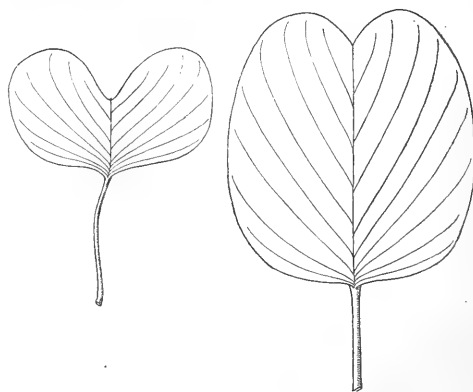


Fig. 50. *Ipomoea pes-caprae* (L.) SWEET. Left: leaf of ssp. *pes-caprae*; right: leaf of ssp. *brasiliensis* (L.) OOSTSTR.  $\times 1/2$ .

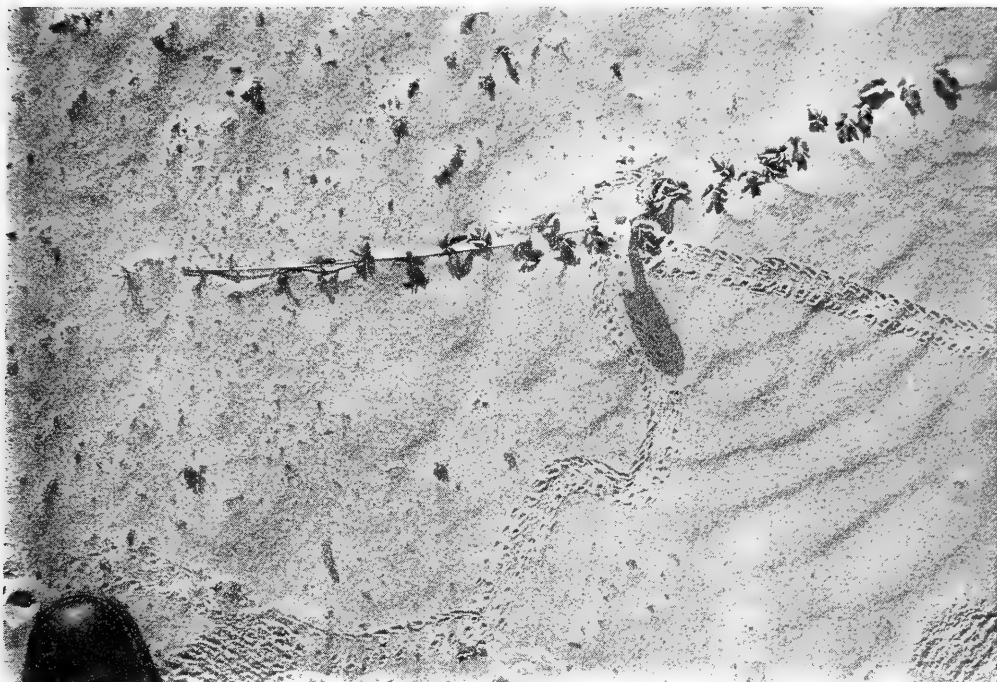


Fig. 51. *Ipomoea stolonifera* (CYRILL.) J. F. GMEL. in the early morning on the beach of the Island of Madura, E. Java; during the previous night a crab has inspected the bud and left a track (JESWIET).

Vern. *Batata pantai*, *daun katang*, *tapak kuda*, *M*, *tang-katang*, *Md*, *katang-katang*, *Bali*, *andali arana*, *Talaud*, *daléré*, *Sangir*, *watata ruruan*, *daredei*, *dolodei*, *daléré*, *kapu'né ruruan*, *kaput i lalawan*, *tilaladé*, *bulalingo*, *alere*, *lèlèri*, *lalère*, *Celebes*, *mari-mari*, *Ceram*, *wèdor*, *wèdule*, *Ambon*, *ngemir-gamir*, *Marind.*, *lololo*, *Halmaheira*; *Philippines*: *arodaidai*, *katang-katang*, *lagairai*, *Tag.* & *Bik.*, *kamigang*, *bagasua*, *Tag.* & *Bis.*, *daripai*, *Tag.*, *Bik.*, *Bis.*, *balim-balim*, *kabai-kabai*, *kamokamotihan*, *tagarai*, *Tag.*, *palang-palang*, *P. Bis.*, *lagilai*, *Bag.*, *lambaiong*, *Sulu* & *Ilk.*, *daloidoi*, *Bik.*, *kamkamote*, *Ilk.*, *vadinó*, *Ivatan*; *geitepoot*, *D.* See for more local names DE CLERCQ-PULLE, *Nieuw Plantk. Woordenb.* ed. 2 (1927) 126, HEYNE, *Nutt. Pl. Ned. Ind.* (1927) 1304, VAN OOSTSTR. *Blumea* 3 (1940) 538.

*ssp. pes-caprae*.—*Convolvulus pes-caprae* LINNÉ, *Sp. Pl.* (1753) 159.—*I. biloba* FORSK. *Fl. Aeg.-Arab.* (1775) 44.—*I. pes-caprae* SWEET *var. biloba* (FORSK.) HALLER *f. Ann. R. Istit. Bot. Roma* 7 (1898) 231.—*I. pes-caprae* (L.) SWEET *ssp. pes-caprae* (L.) OOSTSTR. *Blumea* 3 (1940) 538.—*Fig. 50.*

Differs from the preceding subspecies in the shape of the leaves and the dimensions of calyx and corolla. Leaves in the average smaller, deeply 2-lobed, with rounded lobes, cuneate at the base or attenuate into the petiole. Outer sepals *ca* 9 mm

long, inner ones *ca* 13 mm long. Corolla *ca* 6½ cm long.

*Distr.* Somaliland, tropical Asia, and *Malaysia*: *W. Sumatra* (Batu Islands), *Krakatao*, and *Malay Peninsula* (Penang, probably only cultivated in the Botanic Gardens).

*Ecol.* Sandy beaches.

**21. *Ipomoea asarifolia*** (DESR.) R. & SCH. *Syst.* 4 (1819) 251; OOSTSTR. *Blumea* 3 (1940) 539.—*Convolvulus asarifolius* DESR. in LAMK, *Enc.* 3 (1789) 562.—*I. repens* LAMK, *Tabl. Enc.* 1 (1791) 467, non ROTH 1821.—*Convolvulus rugosus* ROTH. *Ges. Naturf. Fr. Neue Schr.* 4 (1803) 196.—*I. rugosa* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 446.

Herbaceous perennial, much resembling *I. pes-caprae*. Stems prostrate or sometimes twining, thick, terete or angular. *Leaves* orbicular to kidney-shaped, 3½–8 by 3½–10 cm, cordate at the base with rounded lobes, broadly rounded at the apex, not or slightly emarginate, mucronulate; petiole rather thick, with a deep, longitudinal groove above, 3–9 cm long, smooth or minutely muricated. *Inflorescences* axillary, often together with an axillary leafy shoot; peduncles angular, shorter to slightly longer than the petiole, 2–5½ (–10) cm, cymosely one- to few-flowered, at least the central flower with a pedicel much longer than the calyx, 14–24 mm. *Sepals* unequal, the outer

ones shorter, all elliptic-oblong, obtuse, mucronulate; outer ones 3-nerved, more or less muricated, 5–6 mm long, inner ones 8–9 mm. *Corolla* funnel-shaped, ca 5 cm long, glabrous, red-purple. Stamens and style included; filaments shortly pilose at the base. Ovary glabrous. *Capsule* globose, ca 15 mm diam., glabrous. Seeds glabrous, as large as a pea (BAKER & RENDLE).

Distr. Tropical America, Cape Verde Islands, tropical Africa, tropical Asia, in *Malaysia*: E. Java and Bali.

Ecol. In marshy grasslands, and along waysides, from sea-level to 250 m.

Vern. *Kangkong*, Bali.

**22. *Ipomoea stolonifera* (CYRILL.) J. F. GMEL.** Syst. Nat. ed. 13, 2 (1791) 345; OOSTSTR. *Blumea* 3 (1940) 540.—*Convolvulus littoralis* LINNÉ, Syst. ed. 10 (1759) 924.—*Convolvulus stoloniferus* CYRILL. Pl. Rar. Neap. 1 (1788) 14.—*I. carnosa* R. BR. Prod. (1810) 485.—*I. littoralis* BOISS. Fl. Orient. 4 (1879) 112, non BLUME 1825.—Fig. 51–52.

A glabrous perennial. Stems trailing, rooting at the nodes, to 5 m long, terete, glabrous. *Leaves* fleshy, very variable in shape, often of various forms on the same plant, linear, lanceolate, ovate or oblong, with entire or undulate margin, obtuse, truncate or cordate at the base, obtuse or emarginate to 2-lobed at the apex, or the blade is 3–5-lobed with a lanceolate to ovate or oblong, large middle-lobe and smaller lateral ones; blade  $1\frac{1}{2}$ –4(–6) by 1–3(–5) cm; petiole  $\frac{1}{2}$ –4 cm. *Inflorescences* axillary; peduncle short, 12–15 mm, 1- or occasionally 2–3-flowered. Pedicels 8–15 mm, in fruit up to 25 mm. Bracts minute, linear, 2–3 mm long. *Sepals* unequal, inner ones 10–15 mm long, outer ones shorter, all oblong, acutish or obtuse, mucronulate, glabrous, subcoriaceous. *Corolla* funnel-shaped,  $3\frac{1}{2}$ –5 cm long, glabrous, white, pale yellow inside and with a purple centre. Stamens and style included. Filaments hairy at the base. Ovary glabrous. *Capsule* globular, ca 1 cm high, smooth, 2-celled, 4-valved. Seeds 4 or less, ca 8 mm long, short-tomentose and with longer hairs along the edges.

Distr. Tropical and subtropical countries of both hemispheres, in *Malaysia*: apparently rare, Malay Peninsula, Madura Island and the Philippines (Cagayan and Babuyan Islands). Fig. 52.

Ecol. Sandy sea-shores, dunes, from sea-level to 5 m.

Use. It might be of some service as a sand-binder.

**23. *Ipomoea tricolor* CAV.** Icon. 3 (1794) 5, t. 208.—?*I. violacea* LINNÉ, Sp. Pl. (1753) 161; OOSTSTR. *Blumea* 3 (1940) 541.—*I. rubro-caerulea* HOOK. Bot. Mag. (1834) t. 3297.

A herbaceous, glabrous twiner, with terete stems. *Leaves* ovate,  $3\frac{1}{2}$ –7 by  $2\frac{1}{2}$ –6 cm, cordate at the base, long-acuminate at the apex with an acute, mucronulate acumen; petiole  $1\frac{1}{2}$ –6 cm. *Inflorescences* axillary; peduncles as thick as the stems, terete, fistulose, 3–9 cm, cymosely branched at the top. Pedicels much longer than the calyx,

15–18, afterwards up to 25 mm. Bracts minute, triangular. *Sepals* subequal, narrowly triangular to ovate-lanceolate, gradually narrowed towards the apex,  $4\frac{1}{2}$ –6 mm long, green with white margins, carinate on the back. *Corolla* funnel-shaped, 4–6 cm long, glabrous, in bud red with a white tube, in anthesis bright sky-blue with a paler or white tube. Stamens and style included, filaments very unequal, glabrous. Ovary glabrous. *Capsule* ovoid, ca 8–10 mm long, mucronate by the style-base, pale straw-coloured, 2-celled, 4-valved; dissepiment persistent. Seeds 4, nearly 5 mm long, black, minutely puberulent.

Distr. Mexico, Central America, West Indies, tropical South America, elsewhere cultivated and perhaps occasionally escaped, in *Malaysia* only known from the Malay Peninsula (as a garden escape), and Timor, where it is locally frequent in the N. central portion of the island, at 400 m.

Vern. *Non luli*, Timor.

**24. *Ipomoea cairica* (L.) SWEET,** Hort. Brit. (1827) 287; OOSTSTR. *Blumea* 3 (1940) 542.—*Convolvulus cairicus* LINNÉ, Syst. ed. 10 (1759) 922.—*I. palmata* FORSK. Fl. Aeg.-Arab. (1775) 43.—*Convolvulus tuberculatus* DESR. in LAMK, Enc. 3 (1789) 545.—*I. tuberculata* R. & SCH. Syst. 4 (1819) 208.—*Convolvulus paniculatus* (non LINNÉ) NAVES in BLANCO, Fl. Filip. ed. 3 (1877–83) t. 32.

A glabrous twiner (or occasionally prostrate). Root tuberous. Stems more or less tuberculate or smooth. *Leaves* ovate to orbicular in outline, 3–10 by 3–10 cm, palmately cut to the base into 5 lanceolate or ovate-lanceolate to ovate or elliptic, basally and apically acuminate entire segments with acute or obtusish mucronulate apex; the basal pair of segments usually again lobed or parted; petiole 2–6 cm, often with pseudo-stipules (small leaves of the axillary shoot) at its base. *Inflorescences* axillary; peduncle  $\frac{1}{2}$ –7 cm, cymosely one- to few-flowered; pedicels 12–20 mm; bracts minute. *Sepals* glabrous, subequal or the exterior ones slightly shorter, 4–6½ mm, often minutely tuberculate without, with pellucid dots and with pale, scarious margins; outer ones ovate, obtuse to acutish, mucronulate, inner ones broader, obtuse, mucronulate. *Corolla* funnel-shaped,  $4\frac{1}{2}$ –6 cm long, white with a purplish-red tinge on both surfaces and purplish-red towards the base only on the inner surface, occasionally entirely white. Stamens and style included; filaments pilose at the base. Ovary glabrous. *Capsule* subglobose, 10–12 mm high, smooth, 2-celled, 4-valved. Seeds 4 or less, ca 5–6 mm long, densely short-tomentose and with long silky hairs along the edges.

Distr. Widely distributed in tropical Africa and Asia; cultivated and naturalized elsewhere, in *Malaysia* cultivated and/or run wild in the Malay Peninsula, Java, Borneo, Moluccas, Philippines, New Guinea, and the Bismarck Archipelago.

Ecol. Cultivated; wild in waste places, thickets, hedges, etc..

Vern. *Railway creeper*, E, *tatampajan*, M, *patula hutan*, Sandakan, *aurora*, Spanish.



Note. *I. cairica* has been mentioned by several authors under the name of *I. pulchella* ROTH, which is, however, another species, differing *i.a.* by its much smaller, *ca* 1½ cm long, corolla.

**25. *Ipomoea coptica* (L.) ROTH ex R. & SCH. Syst. 4 (1819) 208; OOSTSTR. Blumea 3 (1940) 544.—*Convolvulus copticus* LINNÉ, Mant. 2, App. (1771) 559.—*I. dissecta* WILLD. Phytogr. (1794) 5, t. 2.**

A glabrous annual. Stems slender, trailing, or sometimes twining. *Leaves* orbicular in outline, 1–3 cm long and broad, digitate, with 5 coarsely dentate to deeply and irregularly, once or sometimes twice pinnatifid segments; the teeth or lobes of the segments mostly acute; the middle segment larger than the lateral ones, ovate, oblong, lanceolate or oblanceolate in outline, the two basal segments sometimes 2-lobed again; petiole mostly shorter than the blade, 3–8(–20) mm, with pseudo-stipules (small leaves of the axillary shoot) at its base. *Inflorescences* axillary; peduncles mostly shorter than the leaves, 1–3½ cm long, narrowly 2-alate, cymosely 1–3-flowered. Pedicels 4–5(–7) mm, at first erect, in fruit bent downwards. Bracts lanceolate, entire, small, 1½–3 mm long, acute, or sometimes larger and palmately lacinate like the leaves (*var. acuta* CHOISY in DC. Prod. 9, 1845, 384). *Sepals* subequal, *ca* 4 mm long, oblong or elliptic, minutely cuspidate, thinly coriaceous, verruculose on the back. *Corolla* funnel-shaped, small, *ca* 12 mm long, white. *Capsule* globose, *ca* 7–8 mm diam., glabrous, 3-celled. Seeds 6, *ca* 2½ mm long, densely greyish-tomentose.

*Distr.* Tropical and South Africa to tropical Asia and North Australia, in *Malaysia* mentioned from the Malay Peninsula (Penang) by MIQUEL, Fl. Ind. Bat. 2 (1857) 608, and from West New Guinea by SCHEFFER, Ann. Jard. Bot. Btzg 1 (1876) 39, both under the name of *I. dissecta* WILLD..

**26. *Ipomoea diversifolia* R.Br. Prod. (1810) 487; OOSTSTR. Blumea 3 (1940) 545.—*Pharbitis laciniata* DALZ. in HOOK. Kew J. Bot. 3 (1851) 178.—*I. laciniata* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 200.—Fig. 52.**

A glabrous annual. Stems slender, trailing or twining. *Leaves* orbicular in outline, 1–2½(–5) cm diam., digitate, with 5 coarsely and irregularly dentate to pinnatifid segments, the two basal of which sometimes bifid, the central segment larger than the lateral ones, all narrow-oblong to oblanceolate in outline; petiole mostly shorter than the blade, 3–12(–15) mm long, with pseudo-stipules. *Inflorescences* axillary; peduncles mostly shorter than the leaves, 7–20 mm long, angular or flattened, mostly 1-, sometimes to 3-flowered. Pedicels 8–12(–18), in fruit to 15(–20) mm, erect, also in

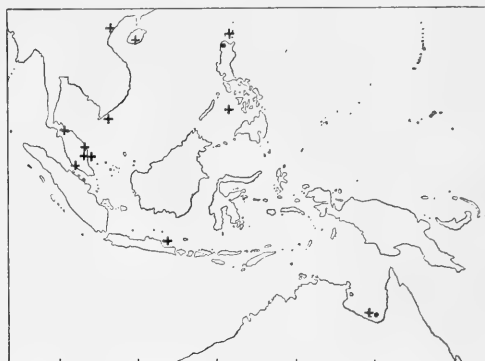


Fig. 52. Distribution in Malaysia of *Ipomoea stolonifera* (CYRILL.) J. F. GMEL. (+) and *Ipomoea diversifolia* R.Br. (•).

fruit. Bracts linear-lanceolate, small, *ca* 3 mm long, very acute. *Sepals* subequal or the inner ones slightly longer, 6–10 mm long, elliptic or narrow-elliptic or oblong-lanceolate, cuspidate or acute, the back more or less carinate and mucronate. *Corolla* tubular to funnel-shaped, small, 5–6 mm long, white, purple inside at the tube. Stamens and style included. *Capsule* subglobose, 8–10 mm diam., glabrous. Seeds short-tomentose.

*Distr.* India to NE. Australia, in *Malaysia*: Philippines (Luzon: Ilocos Norte). Fig. 52.

*Ecol.* In grasslands at low altitudes.

**27. *Ipomoea graminea* R.Br. Prod. (1810) 485; OOSTSTR. Blumea 3 (1940) 546.**

A glabrous twiner. Stems slender. *Leaves* linear, 4–14 cm long or still longer, 2–5 mm broad, obtuse, mucronulate; petiole 4–10 mm; midrib and lateral nerves nearly parallel. Peduncles 1-flowered, 3–5 mm, in fruit up to 12–15 mm. Pedicels 6–9 mm, in fruit up to 15–18 mm. *Sepals* unequal, the inner ones longer; outer sepal elliptic, *ca* 6 mm long, inner ones oblong or ovate-oblong, 7 and 8–10 mm long, somewhat longer in fruit, all obtuse, and mucronulate at the apex. *Corolla* salver-shaped, white, *ca* 4 cm long (according to BENTHAM up to 7½ cm long). Filaments inserted near the corolla-base (perhaps slightly exerted), hairy at their base. Ovary glabrous. *Capsule* ovoid-globose, *ca* 8 mm high, glabrous. Seeds greyish.

*Distr.* North Australia, Queensland, and *Malaysia*: SE. New Guinea and SW. Celebes (Wadjo, N. of Singkang).

*Ecol.* In open savannah-land and in savannah-forests, climbing up grasses *etc.*, *ca* 15–150 m. Flowers opening in the evening.

### 5. Section Calonyction

(CHOISY) GRISEB. Fl. Br. West Ind. Isl. (1864) 466, *p.p.*—*Calonyction* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 441.—*Ipomoea* subg. *Calonyction* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 197.—*Ipomoea* sect. *Leiocalyx* subsect. *Calonyction*



HALLIER f. Med. Rijksherb. Leiden no 46 (1922) 19; OOSTSTR. Blumea 3 (1940) 547.

Annual or perennial herbaceous twiners, mostly glabrous; stems often muricated. *Leaves* cordate, sometimes angular, herbaceous. *Flowers* axillary, solitary, or often in a cincinnus or in a dichasial cyme, nocturnal. *Sepals* herbaceous to membranaceous, glabrous or sometimes hirsute, long-aristate or rarely blunt, subequal or the exterior ones smaller. *Corolla* large, actinomorphic or slightly zygomorphic, white, pink or lilac, glabrous, salver-shaped, the tube long, narrow-cylindrical or rarely widened above the middle. Stamens and style often exserted. Ovary glabrous, 2-celled or rarely 4-celled, 4-ovuled. Capsule 4-valved, 4-seeded. Seeds large, glabrous, dull.

**28. *Ipomoea alba* LINNÉ, Sp. Pl. (1753) 161; OOSTSTR. Blumea 3 (1940) 547.—*Convolvulus aculeatus* LINNÉ, Sp. Pl. (1753) 155.—*I. bona-nox* LINNÉ, Sp. Pl. ed. 2 (1762) 228.—*Calonyction speciosum* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 441, t. 1, f. 4, excl. var. *b*.—*Calonyction bona-nox* BOJ. Hort. Maurit. (1837) 227.—*Convolvulus muricatus* BLANCO, Fl. Filip. ed. 1 (1837) 92.—*Calonyction speciosum* CHOISY var. *muricatum* (non CHOISY) HASSK. Pl. Jav. Rar. (1848) 522, excl. syn. *I. aculeata* BL.—*Calonyction aculeatum* HOUSE, Bull. Torr. Bot. Club 31 (1904) 590.—For a more detailed list of synonyms see HALLIER f. Bull. Herb. Boiss. 5 (1897) 1028, under *Calonyction bona-nox* (L.) BOJ.; see also HALLIER f. Med. Rijksherb. Leiden no 1 (1911) 25, sub 77.—**Fig. 53.****

A glabrous or rarely pubescent annual or perennial<sup>1</sup> twiner, containing a white milky juice. Stems herbaceous or lignescent<sup>1</sup> at the base, slender, terete, to 5 m high, smooth or sometimes muricated. *Leaves* ovate or orbicular in outline, rarely oblong to ovate-oblong, 6–20 by 5–16 cm, the margin entire, or 3-lobed often on the same plant, cordate at the base with a broad or narrow rounded sinus and with broadly rounded or sometimes angular lobes, acuminate at the apex with an acute or obtuse, mucronulate acumen; petiole slender, 5–20 cm. *Inflorescences* axillary, one- to several-flowered; the flowers in a cincinnus, rarely dichasial; peduncle stout, terete, 1–24 cm. Pedicels 7–15 mm, much thickened and clavate in fruit and then up to 25–30 mm. Bracts small, caducous. *Sepals* subcoriaceous, elliptic, glabrous, unequal, the 2 or 3 outer ones shorter, 5–12 mm and with a long, thick, recurved or patent awn, 4–9 mm long; the inner ones longer, 8–15 mm, mucronulate, with a much shorter and thinner mucro, 2–3 mm long; sepals often reflexed in fruit. *Corolla* opening after sunset, fragrant, salver-shaped, white with greenish bands; the cylindrical to slightly angular tube 7–12 cm long, suddenly expanding into a 11–14 cm broad rotate limb. Stamens and style exserted; stamens inserted in the upper part of the corolla-tube; filaments glabrous. Ovary glabrous. *Capsule* ovoid, mucronate, 2½–3 cm high, glabrous, 2-celled, 4-valved. Seeds 4, gla-

brous, yellowish white to brown or black, 10–12 by 7–9 mm.

Distr. Circumtropical; originally in tropical America, in Malaysia cultivated in gardens and run wild.

Ecol. Widely distributed in the settled areas at low and medium altitudes; cultivated and run

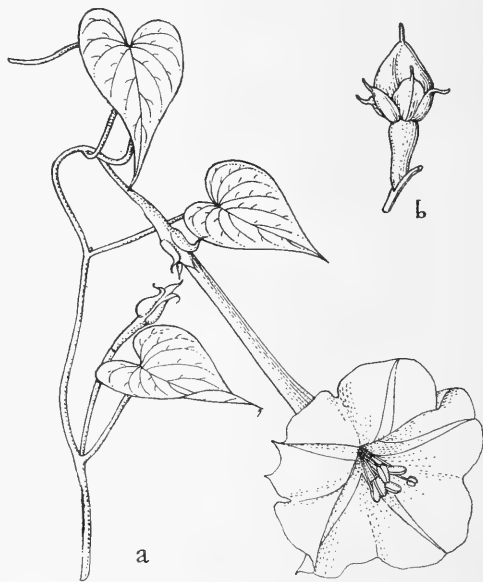


Fig. 53. *Ipomoea alba* L. a. Flowering branch,  $\times 2/5$ , b. unripe capsule,  $\times 1/2$ .

wild in thickets, hedges, along waysides and edges of forests.

Uses. Often cultivated in gardens for its nocturnal, fragrant flowers. The young leaves are eaten as a vegetable (according to HEYNE); the dried flowers (*sundal malam*, *sěděp malam*) are used in pies and in *kimlo* (Chinese vegetable soup) (according to OCHSE).

Vern. Běring rumbi, trulak, andor simar gadung<sup>2</sup>, Sumatra, těrulak, M, terong kori bodas, sundal malam, areuj kutjubung, S, kurulak, klurak,

(1) See HALLIER f. Bull. Herb. Boiss. 5 (1897) 1038 & 1039.

J, *teja*, Alor, *bunga pareh*, Celebes, *pitur*, Minah.; Philippines: *kalakamôte*, *malakamôte*, *kamokamo-tihan*, Tag., Bis., *kakaiuit*, Gad., *pekpeket*, Bont., *moonflower*, *good-night flower*, E, *nachtschone*, D.

Notes. HALLIER f. (Bull. Herb. Boiss. 5, 1897, 1037 & 1038) distinguishes two varieties, each subdivided into two subvarieties, on account of 1. the leaf-shape and 2. the absence or presence of a pubescence. The varieties appear to be of little systematic value as there are many specimens of which the leaves are partly entire and partly 3- to 5-lobed. By far the greater part of the specimens from Malaysia is glabrous; pubescent specimens are very rare.

**29. *Ipomoea muricata* (L.) JACQ.** Hort. Schoenbr. 3 (1798) 40, t. 323, non CAV. 1799; OOSTSTR. Blumea 3 (1940) 551.—*Convolvulus muricatus* LINNÉ, Mant. (1767) 44.—*I. bona-nox* L. var. *purpurascens* KER-GAWL. Bot. Reg. 4 (1818) t. 290.—*Calonyction muricatum* G. DON, Gen. Syst. 4 (1838) 264.—*Calonyction longiflorum* HASSK. Cat. Hort. Bog. (1844) 140.—*Calonyction speciosum* CHOISY var. *muricatum* CHOISY in DC. Prod. 9 (1845) 345, excl. syn. WILLD., LEDEB., BL., DIETR.—*Convolvulus colubrinus* BLANCO, Fl. Filip. ed. 2 (1845) 66.

A glabrous or nearly glabrous twiner, containing a white milky juice. Stems herbaceous, annual, terete or angular, muricated. *Leaves* broadly ovate to orbicular, 7-18 by 6½-15 cm, cordate at the base with wide or narrow sinus and broadly rounded lobes, acuminate at the apex with an acute or

obtuse, mucronulate acumen; petiole 4-12 cm, muricated or smooth. *Inflorescences* axillary, one- to few-flowered; peduncles muricated, 3-6 cm. Pedicels 10-20 mm or longer, smooth, thickened towards the calyx, very thick in fruit. Bracts oblong, acute, ca 8 mm long, scarious. *Sepals* about equal in length; two outer ones oblong to ovate, ca 6-7 mm long, more or less plicate at the top and attenuate into a thick suberect awn, 4-6 mm long; three inner ones ca 7-8 mm long, obtuse or slightly emarginate, distinctly awned, awn ca 4 mm; sepals in fruit patent, afterwards reflexed. *Corolla* opening at night, glabrous, long funnel- to salver-shaped, pale bluish-purple, ca 5-7½ cm long, with a narrow, cylindrical, ca 3-5 cm long tube; tube widened above at the place of insertion of the filaments; limb funnel-shaped to rotate, 5-angular. Stamens and style not or scarcely exerted; stamens inserted in the upper part of the corolla-tube; filaments with some short hairs at the base. Ovary glabrous. *Capsule* ovoid, ca 18-20 mm high, 2-celled, 4-valved. Seeds 4, glabrous, black, ca 9-10 mm long.

Distr. From Mexico to Colombia and Brazil, the West Indies, tropical Africa and adjacent islands to India, China, and Japan, in *Malaysia* cultivated in the Philippines.

Uses. Cultivated as an ornamental. In the Philippines the seeds are used as a remedy against snake-bites; they are also said to be purgative (BROWN, QUISUMBING).

Vern. *Pipita de tonkin*, Philip., *tonkin*, *tunkin*, Tag..

### 6. Section *Quamoclit*

(MOENCH) GRISEB. Fl. Br. West Ind. Isl. (1864) 472.—*Quamoclit* MOENCH, Meth. (1794) 453 ('*Quamoelit*').—*Ipomoea* subg. *Quamoclit* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 198.—*Ipomoea* sect. *Leiocalyx* subsect. *Quamoclit* HALLIER f. Med. Rijksherb. Leiden no 46 (1922) 20; OOSTSTR. Blumea 3 (1940) 552.

Annual (or perennial?) herbaceous twiners, mostly glabrous. *Leaves* cordate, often angular or palmately 3-5-lobed, rarely deeply pinnately divided. *Flowers* mostly axillary, often in a dichasium consisting of two scorpioid cymes or in a real dichasium, rarely solitary. *Sepals* herbaceous to membranaceous, small, glabrous, obtuse, mostly aristate below the apex, subequal or the exterior ones shorter. *Corolla* small or medium-sized, often slightly zygomorphic, often bright red, rarely yellow or white, glabrous, salver-shaped, the tube cylindrical or widened upwards, the limb patent. Stamens and style exerted, usually declinate. Ovary glabrous, 4-celled, 4-ovuled. Capsule 4-celled, 4-valved, 4-seeded. Seeds glabrous or rarely puberulent, dull-black.

**30. *Ipomoea angulata* LAMK.** Tabl. Enc. 1 (1791) 464; OOSTSTR. Blumea 3 (1940) 553.—*I. phoenicea* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 92.—*Quamoclit phoenicea* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 433.—*Quamoclit angulata* BOJ. Hort. Maurit. (1837) 224.—Fig. 54.

An annual twiner. Stems herbaceous, terete or slightly angular, often contorted, 2-5 m high, glabrous or sparsely pilose. *Leaves* mostly gla-

brous, ovate or broadly ovate to orbicular in outline, 3-15 by 3-10 cm, cordate at the base, acuminate and mucronulate at the apex, the margin entire, angular, coarsely dentate or obscurely to deeply 3-lobed, the middle lobe narrowed towards the base; petiole shorter or longer than the blade, 3-12 cm, glabrous or sparsely pilose. *Inflorescences* lateral or terminal, few- to several-flowered, 10-35 cm long; peduncle often longer than the petiole,

3–20 cm, terete or angular, glabrous or pubescent, cymosely branched at the top; first ramification mostly dichasial, subsequent ones monochasial; flowers and fruits on erect pedicels. Pedicels angular, 5–7 mm or longer, in fruit up to 8–12 mm, that of the central flower up to 15 mm. Bracts minute,  $1\frac{1}{2}$ –2 mm, triangular, mucronulate. *Sepals* oblong-rectangular with broadly obtuse or truncate apex and with a large straight or slightly

purposes; run wild in waste places, fields, grasslands, thickets and thin forests, up to 1200 m.

Vern. *Bunga wolanda*, M, *ajong ajong*, *areuj tjatjabeen*, S, *rajutan*, *sanggo langit*, J, *kardinaalsbloem*, D.

Note. Several authors have confounded this with the N. American *I. coccinea* L. (see VAN OOSTSTR. *Blumea* 3 (1940) 555, note). For a discussion of the differences between the two species see HALLIER f. *Bull. Herb. Boiss.* 7 (1899) 415.

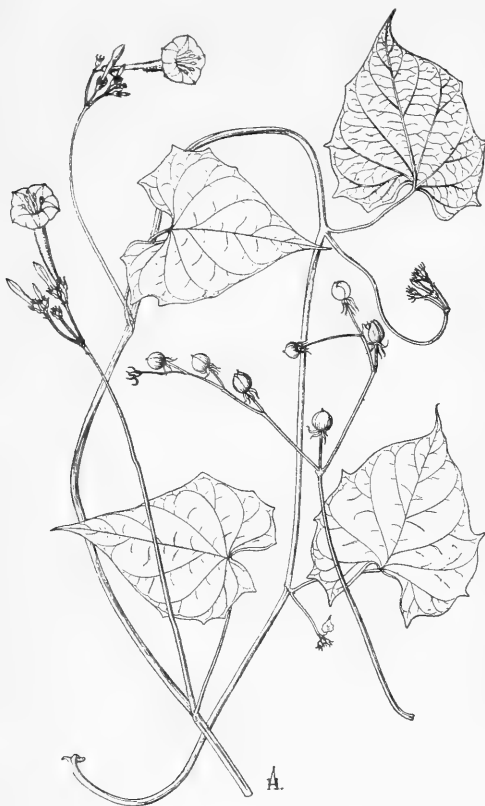


Fig. 54. *Ipomoea angulata* LAMK. Flowering branch, and fruiting peduncle,  $\times \frac{1}{2}$ .

curved awn inserted immediately below the top; outer sepals 2– $2\frac{1}{2}$ , inner ones ca 3 mm long (awn excluded); awn 3–4 mm; sepals in fruit patent, afterwards reflexed. *Corolla* glabrous, salver-shaped, scarlet, the tube 3–4 cm long, narrowed towards the base, slightly curved; the limb patent, up to 2– $2\frac{1}{2}$  cm diam.. Stamens and style exserted; filaments slightly unequal, glabrous. Ovary glabrous. *Capsules* on erect pedicels, globose, 5–7 mm high, glabrous, 4-celled, 4-valved; the dissepiments persistent, pellucid, with a thickened circular margin. Seeds 4, ca 4 mm long, black, densely pubescent.

Distr. Native of tropical America, now circumtropical; in *Malaysia* cultivated and run wild. Ecol. Cultivated in gardens for ornamental

31. *Ipomoea quamoclit* LINNÉ, Sp. Pl. (1753) 159; OOSTSTR. *Blumea* 3 (1940) 555.—*Convolvulus pennatus* DESR. in LAMK, Enc. Meth. 3 (1791) 567.—*Quamoclit vulgaris* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 434.—*Quamoclit pinnata* BOJ. Hort. Maurit. (1837) 224.

An annual glabrous twiner, rarely prostrate. Leaves ovate or oblong in outline, 2–10 by 1–6 cm, pinnatipartite to the midrib, with (8–)10–18 pairs of linear to filiform patent segments, the inferior of which are often bifid; rarely the leaves are less deeply incised [*var. pectinata* (HALLIER f.) OOSTSTR.<sup>1</sup>]; petiole 8–40 mm, at the base often with pseudo-stipules. Inflorescences axillary, cymosely one- to few-flowered; peduncles mostly exceeding the leaves,  $1\frac{1}{2}$ –10(–14) cm. Pedicels much longer than the calyx, (5–)9–20 mm, thickened and clavate in fruit. Bracts minute, deltoid, acute. *Sepals* slightly unequal, outer ones shorter, verruculose outside; all oblong to oblong-spathulate, obtuse, mucronulate somewhat below the apex; outer sepals (mucro excluded) 4– $4\frac{1}{2}$  mm, inner ones (mucro excluded) 5–6 mm long; mucro  $\frac{3}{4}$ –1 mm; margins of sepals pale. *Corolla* glabrous, salver-shaped, red or sometimes white (*var. albiflora* G. DON, Gen. Syst. 4, 1838, 260; OOSTSTR. *Blumea* 3, 1940, 556), the tube  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long, slightly narrowed towards the base, straight; the limb expanded,  $1\frac{3}{4}$ –2 cm diam., 5-lobed with acutish, mucronulate lobes. Stamens and style exserted; filaments hairy at the base. Ovary glabrous. *Capsules* ovoid, obtuse, 6–8 mm long, often crowned by the thickened base of the style, 4-celled, 4-valved, with longitudinally splitting valves, the dissepiments persistent, pellucid, with a thickened circular margin. Seeds 4, ovoid-oblong, 5–6 mm long, blackish-brown, marmorate by tufts of minute hairs.

Distr. Circumtropical, in *Malaysia* cultivated and run wild throughout the region.

Ecol. Cultivated in gardens as an ornamental plant; run wild in waste places, hedges, thickets, thin forests and along edges of cane and rice-fields, up to 1200 m.

Use. In the Philippines the leaves are prepared in poultices and employed as a remedy for bleeding haemorrhoids.

Vern. *Bunga tali-tali*, *sangga langit*, M, *katilan*, *ratjik bumi*, *rintjik bumi*, S, *sëri kading*, Brunei,

(1) *I. quamoclit* LINNÉ *var. pectinata* (HALLIER f.) OOSTSTR. *nov. comb.*—*Quamoclit pinnata* BOJ. *var. pectinata* HALLIER f. Versl. 's Lands Pl.-tuin 1895 (1896) 131.

*bugada*, Celebes, *gambir*, Halmah.; Philippines: *malabokbok*, *agoho*, *agau*, Tag., *lumpitan*, Mag., *malmarama*, *piros-piros*, C. Bis., *sailatan*, *silauak-ankambing*, Sulu, *tartaraok*, *tentenedór*, Iloko, *cabello de angel*, Spanish, *cypress-vine*, *red jasmine*, E, *kardinaalsbloem*, D. For more local names see DE CLERCQ-PULLE, Nieuw Plantk. Woordenb. ed. 2 (1927) 188, under *Quamoclit pinnata* BOJ.

**31a. *Ipomoea* × *sloteri* (HOUSE) OOSTSTR. nov. comb.—*Quamoclit* × *sloteri* HOUSE, Gent. Herb. 1, 3 (1923) 128, f. 60.**

According to HOUSE a hybrid between *I. coccinea* L. and *I. quamoclit* L. differing from the latter by: Leaves deltoid-ovate in outline, pectinately lobed to beyond the middle with *ca* 3–7 linear or linear-lanceolate, acuminate lobes on either side of the midrib; middle segment broadest, basal ones shortest and sometimes again lobed. Corolla salver-shaped, 4–5 cm long, crimson.

Note. Originally cultivated by Mr SLOTER of Columbus, Ohio. In *Malaysia* occasionally found as an ornamental (Malay Peninsula, Java).

## 7. Section *Eriospermum*

HALLIER f. Bot. Jahrb. 18 (1893) 149; OOSTSTR. Blumea 3 (1940) 484, 558.

Perennial plants, very variable in habit, pubescence, leaves and flowers. Flower-buds rarely acute, mostly obtuse, often globular. Sepals mostly obtuse, often orbicular, convex, rarely flat or acute. Seeds with long-bearded edges, further glabrous or rarely the whole surface villose.

**32. *Ipomoea digitata* LINNÉ, Syst. ed. 10 (1759) 924; OOSTSTR. Blumea 3 (1940) 558.—*Convolvulus paniculatus* LINNÉ, Sp. Pl. (1753) 156.—*I. paniculata* R.Br. Prod. (1810) 486, non BURM. 1768.—*Batatas paniculata* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 436.—Fig. 55.**

Distr. Circumtropical; throughout *Malaysia*. Ecol. In thickets on the beach, but also in the interior, in waste places, thickets, hedges, savan-

### KEY TO THE VARIETIES

1. Leaves palmately divided to or mostly beyond the middle . . . . . var. *digitata*
1. Leaves entire or shallowly lobed.

var. *eriosperma*

var. *digitata*.—Fig. 55.

A large perennial twiner, sometimes prostrate. Roots tuberous. Stems terete, glabrous. Leaves glabrous, orbicular in outline, 6–14 by 6–16 cm, palmately divided to or mostly beyond the middle; base more or less cordate or truncate, segments (3–)7(–9), lanceolate to ovate, entire, acuminate with an acute or blunt, mucronulate top; petiole smooth or minutely muricated, 3–10 cm long. Inflorescences axillary; peduncles generally longer than the petioles, terete but often angular near the top, glabrous, cymosely branched, few- to many-flowered, 2½–20 cm. Pedicels longer than the calyx, terete, minutely muricated, glabrous, 9–25 mm long. Flower-buds globular. Sepals equal in length or the outer ones shorter, all orbicular or the outer ones oblong to broadly elliptic, obtuse, concave, coriaceous, 6–12 mm long, pale green, glabrous. Corolla pale reddish-purple, the tube darker inside, funnel-shaped, the tube cylindrical, narrowed at the base, the limb patent; corolla 5–6 cm long, limb 5–7 cm diam.. Stamens and style included, filaments hairy at the base. Ovary glabrous. Capsule ovoid, obtuse, 12–14 mm high, glabrous, 2-celled, 4-valved. Seeds 4, black, with long woolly-sericeous easily detaching hairs.



Fig. 55. *Ipomoea digitata* L. in the Botanic Gardens, Singapore (HENDERSON).

nah-forests, teak-forests, along-fields, and along waysides; also cultivated; up to 700 m.

Uses. Cultivated for ornamental purposes. The root is pounded and applied for swellings

(Malay Peninsula); moreover it is said to be cathartic.

Vern. *Kēledek hutan, kangkong laut, akar kēremak, akar lanar*, Mal. Pen., *rombut, rabet, Kangean, laluli*, Timor, *sablejanin*, Tenimber, *pala puang*, S. Celebes, *kangkung utan, beteta pante*, Minahasa, *ondo*, Talaud, *aurorang gubat, bulakan, puntas puntas*, Tag., *kam-kamôte*, Iloko.

Note. A form with variegated leaves is found in cultivation.

var. *eriosperma* (P.B.) RENDLE, Fl. Trop. Afr. 4, 2 (1905) 190 (*sphalm. eriocarpa*).—*I. eriosperma* P.B. Fl. Owar. 2 (1807) 73, t. 105.—*I. paniculata* (L.) R.Br. var. *eriosperma* O.K. Rev. Gen. Pl. 2 (1891) 445 (*sphalm. eriocarpa*); HALLIER f. Bot. Jahrb. 18 (1894) 150 (*id.*).—*I. paniculata* (L.) R.Br. var. *indivisa* HALLIER f. Bull. Herb. Boiss. 5 (1897) 378.

As var. *digitata*, but the leaves entire or shallowly lobed; nerves 2–4 on either side of the midrib.

Distr. Probably throughout the range of var. *digitata* but apparently very rare in Malaysia: West New Guinea.

33. *Ipomoea asterophora* OOSTSTR. Blumea 3 (1940) 561.

#### KEY TO THE VARIETIES

1. Leaves densely covered with stellate hairs on both surfaces; stems with similar hairs mainly at the nodes . . . . . var. *asterophora*
1. Leaves with stellate hairs below on the nerves only, or entirely glabrous; stems with similar hairs over the whole surface or only at the nodes. . . . . var. *subglabra*

var. *asterophora*.

Stems twining, terete, stellately hairy mainly at the nodes, glabrescent. *Leaves* broadly ovate to orbicular, 7–16 by 7½–12 cm, broadly cordate at the base, attenuate to shortly acuminate at the apex with a broadly triangular, obtuse to slightly emarginate, mucronulate acumen; margins entire, slightly undulate or more or less deeply lobed with 1–2 broad or narrow triangular obtuse lobes on either side, stellately hairy on both surfaces; lateral nerves strongly curved, 3–4 on either side of the midrib, 2–3 of which rising from the leaf-base; petiole with stellate hairs, glabrescent, 3–8 cm long. *Inflorescences* axillary; peduncles terete or slightly angular, ca 6–15 cm long, 2–6- or sometimes more-flowered, stellately hairy to glabrous. Pedicels slender, longer than the calyx, 1–2 cm. Bracts minute, caducous. *Sepals* slightly unequal, outer ones elliptic, 7–9 mm long, inner ones orbicular, 9–10 mm long, all concave with rounded apex, subcoriaceous, glabrous or the outer ones sparsely hairy with stellate hairs. *Corolla* pale purplish or purplish white, darker purple inside towards the base, campanulate to funnel-shaped, ca 7 cm long, glabrous. Stamens and style included; filaments hairy at the base. Ovary glabrous.

Distr. *Malaysia*: Kangean Islands, Moluccas (Ceram), W.–E. New Guinea.

Ecol. River-banks, up to 100 m.

var. *subglabra* OOSTSTR. Blumea 3 (1940) 563.

Differs from var. *asterophora* by the much less dense to almost lacking indument; the stems may be stellately hairy over the whole surface but specimens with nearly glabrous stems are also found; such almost glabrous stems still bear a few stellate hairs at the nodes. Leaves with stellate hairs below on the nerves only, or entirely glabrous; petioles stellately hairy to glabrous.

Distr. *Malaysia*: West New Guinea; a fragmentary specimen (TEYSMANN 12114) collected in SW. Celebes (near Pangkadjene) may belong to this variety.

Ecol. As in var. *asterophora*.

34. *Ipomoea horsfalliae* Hook. Bot. Mag. (1834) t. 3315; OOSTSTR. Blumea 3 (1940) 564.

A large, glabrous twiner. Stems terete, the adult parts woody, lenticellate. *Leaves* orbicular in outline, 5–20 by 5–20 cm, deeply palmately lobed to beyond the middle or to the base into 3–5 segments; middle segment mostly much larger than the lateral ones, ovate, elliptic or elliptic-oblong, mostly attenuate towards both ends, acuminate at the apex with acute or obtusish, mucronulate point; lateral segments ovate-lanceolate to linear-lanceolate; margins of segments slightly crisped, entire or coarsely dentate to crenate; petiole shorter than the blade, 2½–13 cm. *Inflorescences* axillary, 8–30 cm long, few- to several-flowered; peduncle 1½–14 cm, widely cymosely branched. Pedicels as long as or longer than the sepals, 8–15 mm. *Sepals* subequal or the outer ones slightly shorter, elliptic or ovate-elliptic, obtuse, concave, 7–10 mm long, green at the base, for the rest red-purple or purplish black. *Corolla* red or red-purple, salver-shaped, the tube slightly angular, somewhat narrowed to the base, ca 4 cm long, ca 1 cm diam.; limb ca 4–4½ cm diam., 5-lobed with rounded lobes. Stamens and style exserted; filaments pale purple, densely villous at the base; style white, stigma dark purple, ovary glabrous.

Distr. Native of the West Indian Islands, cultivated throughout the tropics, also in *Malaysia*.

Use. Cultivated in gardens for ornamental purposes.

Vern. *Red Stephanotis*, E, *rode Clematis*, *rode Stephanotis*, D.

Note. Caterpillars of *Euchromia horsfieldi* MOORE feed on the leaves of this species.

35. *Ipomoea riparia* G. DON, Gen. Syst. 4 (1838) 265; EXELL, Cat. Vasc. Pl. S. Tomé (1944) 251.—*I. lilacina* BL. Bijdr. (1825) 716, non SCHRANK 1822.—*Pharbitis fragrans* BOJ. ex CHOISY in DC. Prod. 9 (1845) 341.—*I. fragrans* BOJ. ex HALLIER f. Bot. Jahrb. 18 (1893) 153; OOSTSTR. Blumea 3 (1940) 564.

A perennial hairy twiner. Stems terete, densely short-pilose with soft whitish hairs. *Leaves* broadly ovate to orbicular, 5–15 by 4–12 cm, broadly

cordate at the base, acuminate at the apex with an acute or obtuse mucronulate point, densely pilose beneath, much more sparsely so and glabrescent above; nerves 7-9 on either side of the midrib; petiole slender, 3-12 cm, pilose like the stem. *Inflorescences* axillary; peduncle terete, 2-14 cm long, pilose like the stem, often glabrous or nearly so in the basal portion, cymosely one- to few-flowered with very short branches; flowers consequently subumbellate. Pedicels pilose, mostly longer than the calyx,  $\frac{3}{4}$ -1 $\frac{1}{2}$  cm, in fruit up to 2 cm. *Sepals* equal in length,  $\frac{3}{4}$ -1 cm, the 2 outer ones elliptic-oblong, acute, shortly pilose, the inner ones broader, ovate-elliptic, less acute. *Corolla* pink or purple with a darker centre, funnel-shaped, 4-5 cm long, with sericeous hairs on the midpetaline bands outside. Stamens and style included. Filaments hairy at the flattened base. Ovary glabrous. *Capsule* globose, 12 mm diam., glabrous, 2-celled, 4-valved. Seeds 4, ca 6 mm long, white-villous.

Distr. Guianas, tropical Africa, Madagascar and adjacent islands, in *Malaysia*: Sumatra, Java, Borneo, Lesser Sunda Islands (Bali), Philippines (Luzon, Mindanao).

Ecol. In marshes, along rivers, and in marshy forests, occasionally in waste places, up to 1000 m.

**36. *Ipomoea illustris* (CLARKE) PRAIN**, Beng. Pl. 2 (1903) 735; OOSTSTR. *Blumea* 3 (1940) 566.—*I. campanulata* auct. div., non L. 1753.—*I. campanulata* L. var. *illustris* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 211.

A woody twiner, rarely prostrate and rooting. Stems longitudinally wrinkled to angular<sup>1</sup>, glabrous or pubescent. *Leaves* ovate to orbicular, sometimes ovate-oblong, 6-16 by 3 $\frac{1}{2}$ -14 cm, shallowly cordate to truncate at the base, acuminate at the apex with a short or long and narrow, acute or obtusish, mucronulate acumen; margin entire or undulate; surfaces glabrous or lower surface pubescent; nerves 10-15 on either side of the midrib; petiole slender, 3-10 cm, glabrous or pubescent. *Inflorescences* axillary; peduncle stout, 1-8 cm long, glabrous or rarely pubescent, cymosely one- to several-flowered. Pedicels 1-1 $\frac{1}{2}$ -(2 $\frac{1}{2}$ ) cm, in fruit to 3 cm, angular, thickened towards the calyx, glabrous or rarely pubescent. *Sepals* slightly unequal, glabrous or rarely pubescent, coriaceous, with pale thinner margins, orbicular with rounded apex; outer ones 7-10(-15), inner ones 10-12(-18) mm long, in fruit up to 14-15 and 18 mm or still longer. *Corolla* reddish purple with a darker centre, paler without, sometimes pale purple or rarely white, tubular to funnel-shaped, up to 10 cm long, contracted at ca 1 $\frac{1}{2}$  cm above the base. Stamens and style included. Filaments hairy at the base. Ovary glabrous. *Capsule* ovoid, ca 1 $\frac{1}{2}$  cm long, brown, 2-celled, 4-valved. Seeds 4,

ca 8-9 mm long, black, with long silky hairs along the margins.

Distr. India, Ceylon, Indo-China, Siam, Andamans, in *Malaysia*: Sumatra, Malay Peninsula, Java, Borneo, Celebes, Lesser Sunda Islands (Bali), Moluccas (Ceram), New Guinea (Papua), Philippines (Luzon).

Ecol. Sea-shores, and in thickets and along edges of forests near the sea, up to 25 m.

Vern. *Olor bauwo uding*, Simalur, *blaran*, Java (Pekalongan), *budokkin*, Minah..

Note. This species is generally known both in systematic literature and in herbaria under the name of *I. campanulata* LINNÉ. However, the type of *I. campanulata* L. is conspecific with the *Malvaceae* *Thespesia populnea* (L.) SOLAND., as appears from LINNAEUS's description and herbarium (see HALLIER f. Med. Rijksherb. Leiden no 1, 1910, 26; VAN OOSTSTROOM *Blumea* 3, 1940, 568; KERR, Kew Bull. 1941, 18). The synonym *Adamboe RHEEDE*, mentioned by LINNAEUS under *I. campanulata* most probably belongs to *Strictocardia tilifolia* (DESR.) HALLIER f..

**37. *Ipomoea crassicaulis* (BENTH.) B. L. ROBINSON**, Proc. Amer. Acad. 51 (1916) 530; OOSTSTR. *Blumea* 3 (1940) 569.—*Batatas crassicaulis* BENTH. Voy. Sulph. (1844) 134.—*I. fistulosa* MART. ex CHOISY in DC. Prod. 9 (1845) 349.

A shrub, 1-2 $\frac{1}{2}$  m high, erect or ascending, or sometimes twining, and to 5 m high. Branches thick, terete to angular, fistulose or solid, containing a white milky juice, the adult parts lenticellate, pale greyish, the younger parts densely puberulent, glabrescent. *Leaves* ovate or ovate-oblong, 6-25 by 4-17 cm, cordate to truncate at the base, acuminate at the apex, with an acute or obtuse, mucronulate acumen; young leaves densely puberulent on both surfaces, adult ones puberulent below, mainly on the nerves, glabrous or nearly so above; midrib below with 2 small glands at the base of the leaf-blade; lateral nerves 7-9 on either side of the midrib, secondary nerves many, parallel; petiole slender, 2 $\frac{1}{2}$ -15 cm. *Inflorescences* axillary and terminal; peduncle stout, terete, 5-15 cm long, puberulent or glabrous, cymosely several- to many-flowered. Pedicels longer than the calyx, puberulent. Bracts minute, ovate, obtuse, caducous. *Sepals* subequal or the outer ones slightly shorter, 5-6 mm long, orbicular, broadly rounded, puberulent; calyx with 5 nectaries between the sepal-bases. *Corolla* pink or pale lilac, inside often dark purple towards the base, tubular to funnel-shaped, 7 $\frac{1}{2}$ -9 cm long, limb 8-12 cm diam.; tube constricted close to the base; tube and midpetaline bands minutely puberulent outside, connecting fields glabrous or nearly so. Stamens and style included. Filaments very unequal, hairy at the dilated base. Ovary and basal part of the style puberulent. *Capsule* ovoid, mucronate, 1 $\frac{1}{2}$ -2 cm long, pale brown, finely puberulent in the basal portion, incompletely 4-celled, or 2-celled, 4-valved. Seeds 4 or less, black, their whole surface sericeo-villous.

(1) Stems, peduncles and pedicels may be warty by galls (see DOCTERS VAN LEEUWEN, Zoöecid. Neth. E. Ind. 1926, 474, no 1262, under *Calonyction spec. div.*).

Distr. Native of America, from Mexico, Florida and the West Indies S. as far as Brazil and Paraguay, in *Malaysia* cultivated and run wild occasionally.

Ecol. Escaped from cultivation and naturalized at low altitudes along rivers, canals, sometimes on the beach; locally abundant.

Use. Cultivated as an ornamental plant; the leaves are eaten as a vegetable by the Madurese.

Vern. *Klēmūt, kangkungan, ula, daun krangkungan, J.*

Note. In exposed situations the plant is shrubby, but twines up if under shade (FURTADO in Herb. Singapore). It is sometimes found in cultivation under the erroneous name *I. carnea* JACQ.

**38. *Ipomoea sumatrana* (MIQ.) OOSTSTR.** *Blumea* 3 (1940) 571.—*Lettsomia sumatrana* MIQ. Fl. Ind. Bat. Suppl. (1861) 560.—*I. staphylina* R. & SCH. var. *malayana* PRAIN, J. As. Soc. Beng. 63, 2 (1894) 106.—*Argyreia sumatrana* BOERL. Handl. Fl. Ned. Ind. 2 (1899) 513.

A large, woody, glabrous twiner. Stems terete or angular, fistulose, greyish brown. *Leaves* ovate or rarely broadly ovate, 6–12 by 5–10 cm, slightly cordate or truncate at the base, obtuse or acute to shortly acuminate at the apex; lateral nerves prominent beneath, 11–14 on either side of the midrib; petiole slender, 4–10 cm. *Inflorescences* axillary, 6–18(–30) cm long, paniculate, one or two times racemously branched, the ultimate partial inflorescences cymose; large inflorescences with leaflike bracts at the base of the lowest branches; peduncle under the lowest branch ca 3–6 cm long. Pedicels longer than the calyx, 6–10 mm. Outer *sepals* broadly ovate, obtuse, ca  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm long, coriaceous, slightly shorter than the inner ones; inner sepals orbicular, broadly rounded, ca  $4\frac{1}{2}$ –5 mm long, coriaceous with scarious margins. *Corolla* white or slightly tinged with pink, tubular to funnel-shaped,  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long, glabrous; tube ca 5–6 mm wide; midpetaline bands with many minute, dark, glandular lines. Stamens and style included. Filaments sparsely pilose at the dilated base. Ovary glabrous. *Capsule* ovoid, subacute, ca  $7\frac{1}{2}$  mm long. Seeds 4, with long, silky hairs.

Distr. Siam and *Malaysia*: Sumatra (only known from the type loc., Sungei Pagu, W. Coast), Malay Peninsula (Perlis, Kedah, Penang, Perak, Pahang), Java (Salatiga); perhaps also in the Lesser Sunda Islands (Sumbawa, Timor?).

Ecol. Probably in thickets, up to 1000 m.

Vern. *Akar kējtjambang, Sumatra.*

Note. The majority of the specimens have been found in the Malay Peninsula. In Sumatra and in Java the species appears to be very rare. The specimen Mrs RENSCH 619, from Sumbawa, in Herb. Bog. is somewhat aberrant; it has the stems minutely warty, the peduncles thinner and few-flowered, and the corolla white with a dark red centre. ELBERT 3740, also from Sumbawa, in Herb. Leyden, a sterile specimen, is perhaps conspecific and so is a specimen from Timor, collected by WILES & SMITH s.n. in Herb. Brit. Mus..

**39. *Ipomoea aculeata* BL. Bijdr. (1825) 715; OOSTSTR. *Blumea* 3 (1940) 572.—*Calonyction mollissimum* ZOLL. var. *glabrior* MIQ. Fl. Ind. Bat. 2 (1857) 597.—*I. mollissima* HALLIER f. var. *glabrior* BOERL. Handl. Fl. Ned. Ind. 2 (1899) 512.**

#### KEY TO THE VARIETIES

1. Plant glabrous or nearly so. . var. *aculeata*
1. Plant softly pubescent, or short-tomentose. var. *mollissima*

var. *aculeata*.

A glabrous or nearly glabrous twiner, to 10–15 m, occasionally prostrate. Stems woody, grey or pale straw-coloured, often thickened at the nodes, terete to angular, smooth or muricated with small curved hooks. *Leaves* ovate to orbicular, entire or rarely 3-lobed, 5–14 by 3–10 cm, cordate to truncate at the base, if cordate with a narrow to very broad sinus and rounded basal lobes, acuminate at the apex, with a short or long and narrow, acute or obtusish, mucronulate acumen; lateral nerves 5–6 on either side of the midrib; petiole slender,  $2\frac{1}{2}$ –8(–12) cm, smooth or sometimes with some acute warts. *Inflorescences* axillary, one- to few-flowered; peduncle short, 2–10(–15) mm. Pedicels terete or angular and thickened towards the calyx, 7–15 mm, in fruit clavate and to 20 mm, recurved in bud, afterwards erect, finally recurved again. *Sepals* coriaceous, broadly elliptic or orbicular, rarely narrower, broadly rounded to emarginate at the apex and minutely mucronate, 12–18 mm long, in fruit to 20 mm, the inner ones mostly somewhat shorter than the outer and with a narrow scarious margin. *Corolla* white, greenish outside, opening at night, fragrant, salver-shaped, 14–17 cm long, tube long and narrow. Stamens and style exerted. Filaments inserted at the mouth of the tube, hairy at their base. Ovary glabrous. *Capsule* enclosed by the sepals, ovoid, mucronate, ca 15 mm long, 2-celled, 4-valved, with more or less lacerate valves. Seeds 4, densely grey-woolly, 6–8 mm long.

Distr. *Malaysia*: N. Sumatra (Karolands), Java, Lesser Sunda Islands (Wetar).

Ecol. In thickets and thin forests, from sea-level to 700 m.

Use. The pulverized top of the plant is used in the Karolands, Sumatra, as a medicine against boils.

Vern. *Waren tan tan, Karo-Batak, klorak, S.*

Note. The type of *Calonyction mollissimum* ZOLL. var. *glabrior* MIQ. is a transition between this var. and the next one, as to the density of the indumentum.

var. *mollissima* (ZOLL.) HALLIER f. ex OOSTSTR. *Blumea* 3 (1940) 574.—*Calonyction mollissimum* ZOLL. Syst. Verz. 2 (1854) 128, 131.—*I. yomae* KURZ, For. Fl. Brit. Burma 2 (1877) 218.—*I. mollissimum* HALLIER f. ex BOERL. Handl. Fl. Ned. Ind. 2 (1899) 512.

Differs from var. *aculeata* in being pubescent or short-tomentose.



Distr. Possibly in continental Asia (Silhet, Pegu, and Tenasserim), in *Malaysia*: M. & E. Java, Madura, Lesser Sunda Islands (Lombok, Sumbawa, Timor, Alor), and Philippines (Luzon).

Ecol. In thickets and thin forests, from sea-level to 700 m.

Use. The leaves are used as a purgative and as a substitute for soap (HEYNE).

Vern. *Uluk-uluk*, *S*, *rabet kalorak*, *klorak*, *Md*.

**40. *Ipomoea tuba* (SCHLECHTEND.) G. DON**, Gen. Syst. 4 (1838) 271; OOSTSTR. *Blumea* 3 (1940) 575.—*Convolvulus grandiflorus* JACQ. Hort. Vin-dob. 3 (1776) 39, t. 69, non LINNÉ f. 1781.—*Convolvulus tuba* SCHLECHTEND. *Linnaea* 6 (1831) 735.—*Calonyction grandiflorum* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 442, note.—*I. glaberrima* BOJ. ex BOUTON in HOOK. Journ. Bot. 1 (1834) 357.—*Calonyction muticum* DECAISNE, Nouv. Ann. Mus. Par. 3 (1834) 390.—*Convolvulus catharticus* BLANCO, Fl. Filip. ed. 1 (1837) 94, acc. to MERRILL.—*I. grandiflora* HALLIER f. Bot. Jahrb. 18 (1893) 153, non LAMK, 1791, nec ROXB. 1832.—*Calonyction album* HOUSE, Bull. Torr. Bot. Club 31 (1904) 591, as to the description, not *I. alba* L. 1753, see HALLIER f. Med. Rijksherb. Leiden no 1 (1911) 24, sub 76.

A glabrous twiner. Stems woody, straw-coloured in dry specimens, terete or angular, often longitudinally wrinkled, smooth or rarely muricated. *Leaves* orbicular or ovate, 5–16 by 5–14 cm, deeply cordate at the base, with rounded or rarely angular lobes, acuminate at the apex, with obtuse, mucronulate tip; lateral nerves 7–8 on either side of the midrib, secondary nerves parallel, tertiary nervation distinctly reticulate (in dry specimens the secondary and tertiary nervation often pellucid); petiole  $3\frac{1}{2}$ –16 cm. *Inflorescences* axillary, one- to few-flowered; peduncle terete, variable in length,  $3\frac{1}{4}$ –7(–12) cm. Pedicels angular,  $1\frac{1}{2}$ –3 cm long, thickened to clavate in fruit. *Sepals* orbicular, with broadly rounded to emarginate, mucronulate apex, equal in length or the inner ones slightly longer, outer ones 15–20 mm, inner ones 18–25 mm long, all coriaceous, the inner ones somewhat thinner; sepals enlarged in fruit, at first enclosing the capsule as a cup, afterwards reflexed against the pedicel, 20–30 mm long. *Corolla* white, with greenish bands, opening at night, salver-shaped, 9–12 cm long, tube cylindrical, 7–8 cm, limb *ca* 8–10 cm in diam.. Stamens and style included. Filaments inserted near the base of the corolla-tube, hairy at their base. Ovary glabrous. *Capsule* globular, 2–2½ cm long, glabrous, pale-brown, 2-celled, 4-valved. Seeds 4, black, densely short-tomentose and with longer (to *ca* 3 mm) sericeous hairs along the edges, 1 cm long.

Distr. Tropical America, East tropical Africa, Mascarene Islands, and tropical continental Asia to Polynesia, throughout *Malaysia*.

Ecol. On the beach and in thickets near the sea.

Use. Used on the Sula Isl. as a remedy in maladies resulting from pregnancy.

Vern. *Alor bauwo alas*, Simalur, *tatampajan bésar*, M, *mingumbai botti*, *bañ bot*, Sula, *ganga-*

*mielke*, W. New Guinea, *lambatung*, Sulu, *bulacan*, Tag..

Note. This species has often been identified with *I. grandiflora* (L. f.) LAMK, Tabl. Enc. 1 (1791) 467 (= *Convolvulus grandiflorus* L. f. Suppl. 1781, 136). From the description of the latter it is evident that the specimen of KÖNIG, described by LINNAEUS f. belongs to another species. The pubescent stems and petioles as described by LINNAEUS f. are never found in *I. tuba*. HALLIER f. (Jahrb. Hamb. Wiss. Anst. 15, 1898, 45; & Med. Rijksherb. Leiden no 1, 1911, 25) considers *Convolvulus grandiflorus* L. f. conspecific with *Stictocardia tiliifolia* (DESR.) HALLIER f..

A specimen from Ternate, BEGUIN 1655, in Herb. Bog. has the seeds long hairy at the margins and otherwise glabrous.

**41. *Ipomoea trichosperma* BL.** Bijdr. (1825) 710; OOSTSTR. *Blumea* 3 (1940) 578.—*Calonyction trichospermum* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 442.—*I. capillata* SPANOGHE, *Linnaea* 15 (1841) 340.—*Calonyction diversifolium* HASSK. Flora, Beibl. 2 (1842) 29.—*Calonyction trichospermum* CHOISY var. *diversifolium* CHOISY in DC. Prod. 9 (1845) 346.—*Calonyction capillatum* MIQ. Fl. Ind. Bat. 2 (1857) 598.—*I. longiflora* R.Br. var. *diversifolia* HALLIER f. Versl. 's Lands Pl.-tuin 1895 (1896) 130.—*I. trichosperma* BL. var. *diversifolia* BOERL. Handl. Fl. Ned. Ind. 2 (1899) 512.

A glabrous twiner. Adult stems woody, pale brown, terete, smooth or minutely verrucose; young branches green. *Leaves* orbicular or transverse-elliptic in outline, 6–12 by 6–12 cm, (3–)5(–7)-lobed mostly far beyond the middle, the middle lobe elliptic or lanceolate, 5–8 by 2–5 cm, attenuate towards both ends, acuminate at the apex with a narrow, acute or obtusish, mucronulate acumen; the lateral lobes slightly smaller, obliquely ovate to lanceolate, long-acuminate, the basal lobes much smaller; leaf-base cordate with broadly rounded sinus; rarely the leaf-margin is entire or coarsely dentate; petiole slender,  $4\frac{1}{2}$ –12 cm. *Inflorescences* axillary, one-flowered, or dichasial or partly monochasial and few-flowered; peduncles 2–14 cm, terete, smooth. Pedicels more or less angular, thickened towards the calyx, 13–30 mm long. *Sepals* pale green, very unequal, the outer ones much shorter than the inner; sepals 1 & 2 coriaceous, broadly elliptic to orbicular, broadly rounded at the apex, mucronulate, 8–12 and 10–18 mm long; inner sepals coriaceous with scarious margin; sepal 3 broadly elliptic to orbicular, broadly rounded, mucronulate, *ca* 16–25 mm; sepals 4 & 5 broadly elliptic, rounded and mucronulate, *ca* 20–30 mm. *Corolla* white with reddish midpetaline bands, or entirely white, salver-shaped, 11–14 cm long, tube long and narrow, 8–9 cm, limb *ca* 10 cm diam.. Stamens and style exserted. Filaments inserted near the base of the corolla, hairy at their base. Ovary glabrous. *Capsule* broadly ovoid to globose,  $2\frac{1}{2}$ –3 cm long. Seeds 7–9 mm long, densely brown-tomentose



and with long (10–12 mm) brownish sericeous patent hairs along the edges.

Distr. *Malaysia*: Java, Celebes (Salajar and Buton Isl.), Lesser Sunda Islands (Sumbawa, Timor, Alor).

Ecol. In thickets, hedges and thin forests, near the beach and in the interior; from sea-level to 400 m.

Vern. *Aroi uwat guling*, S, *tropongan*, J, *nachtschone*, D.

#### Cultivated only

Mentioned for *Malaysia* only on the basis of a single cultivated specimen:

*Ipomoea* (sect. *Calonyction*) *campaniflora* HALLIER f. Med. Rijksherb. Leiden no 46 (1922) 20; OOSTSTR. *Blumea* 3 (1940) 580.—*Calonyction campanulatum* HALLIER f. Bull. Herb. Boiss. 5 (1897) 1050, t. 18, f. 2; MERR. En. Philip. 3 (1923) 369.

Distr. Native of Mexico and Central America. MERRILL mentions a cultivated specimen from the Philippines (Luzon).

Vern. *Suma-ñg-nagisit*, Iloko.

*Ipomoea* (sect. *Leiocalyx*) *dasysperma* JACQ. Eclog. 1 (1811–16) 132, t. 89; OOSTSTR. *Blumea* 3 (1940) 580.

Distr. Tropical Africa and India. Formerly

cultivated in the Botanic Gardens, Bogor, Java. Vern. *Aroy kawoijang*, S.

#### Insufficiently known

*Ipomoea reflexa* SPANOGHE, *Linnaea* 15 (1841) 341; OOSTSTR. *Blumea* 3 (1940) 581.

Described from the island of Rotti.

#### Doubtful

*Ipomoea repanda* JACQ. En. Pl. Carib. (1760) 13; OOSTSTR. *Blumea* 3 (1940) 581.

FAWCETT in FORBES, Wander. (1885) 511, mentions a specimen from Timor, collected near Kupang by WILES & SMITH. It is unlikely that the West Indian *I. repanda* occurs in Timor. There is, however, a possibility that FAWCETT referred to a specimen WILES & SMITH s.n. in Herb. Brit. Mus., that most probably belongs to 38. *Ipomoea sumatrana* (MIQ.) OOSTSTR.

#### Excluded

*Ipomoea aspera* VATKE, *Linnaea* 43 (1880–82) 508; OOSTSTR. *Blumea* 3 (1940) 582.

HALLIER f. Bot. Jahrb. 18 (1893) 154, mentions this species for Sumatra. The specimen appears to belong to the *Menispermaceae* (cf. HALLIER f. Bot. Jahrb. 28, 1899, 52).

### 17. MINA

CERV. in DE LA LLAVE & LEX. Nov. Veg. Desc. fasc. 1 (1824) 11; OOSTSTR. *Blumea* 5 (1943) 339.—*Ipomoea* subg. *Quamoclit* sect. *Mina* MEISSN. in MART. Fl. Bras. 7 (1869) 220.—*Quamoclit* sect. *Mina* HOUSE, Bull. Torr. Bot. Club 36 (1909) 596.

Herbaceous twiner. *Leaves* petioled, entire or mostly palmately lobed. *Flowers* in axillary, peduncled, few- to several-flowered cincinni or double cincinni, often secund; pedicels short. Bracts minute. *Sepals* 5, subequal, herbaceous, distinctly awned, not enlarged in fruit. *Corolla* suddenly widened above a short narrow tubular basal part; limb long-urceolate to tubular, subangular, slightly curved, with a slightly constricted 5-toothed mouth. *Stamens* and style long-exserted. Filaments inserted at the top of the narrow basal tubular part of the corolla; pollen globular, spinulose. Disk annular. *Ovary* glabrous, 4-celled, each cell with 1 ovule; style 1, simple, filiform; stigmas 2, capitate. *Capsule* 4-celled, 4-valved. Seeds 4 or less, glabrous.

Distr. Monotypic, Mexico to Central and S. America, introduced in *Malaysia*.

1. *Mina lobata* CERV. in DE LA LLAVE & LEX. Nov. Veg. Desc. fasc. 1 (1824) 12; OOSTSTR. *Blumea* 5 (1943) 339.—*Quamoclit mina* G. DON, Gen. Syst. 4 (1838) 259.—*Ipomoea versicolor* MEISSN. in MART. Fl. Bras. 7 (1869) 220.—*Quamoclit lobata* HOUSE, Bull. Torr. Bot. Club 36 (1909) 602.

Perennial, glabrous twiner. Stems 2–5 m, slender, terete. *Leaves* broadly ovate in outline, 6–15 cm long and nearly as broad, cordate at the base, entire or mostly 3-lobed; lobes acuminate, the middle

lobe constricted below, the lateral ones with some coarse teeth or often again lobed; petiole 3–10 cm. *Inflorescences* up to 35 cm long (peduncle included), *flowers* in single or double cincinnal cymes, secund; pedicels 4–8 mm; bracts minute. *Sepals* oblong, 5–6 mm long, the 2–3 mm long awn included. *Corolla* at first red, afterwards pale yellow or whitish, the narrow basal part 5–8 mm, the slightly curved widened limb 17–20 mm long, the teeth mucronulate. Stamens and style finally

twice as long as the corolla; filaments pubescent towards the base. Disk shallowly 5-lobed. Ovary glabrous. Capsule broadly ovoid, 6-8 mm long.

Distr. Mexico to Central and S. America, cultivated in other tropical and temperate regions. Ecol. Cultivated for ornamental purposes (Malay Peninsula, Java), above 200 m.

18. LEPISTEMON

BL. Bijdr. (1825) 722; OOSTSTR. Blumea 5 (1943) 340.—*Lepidostemon* HASSK. Cat. Hort. Bog. (1844) 140.—*Nemodon* GRIFF. Not. 4 (1854) 286.—*Ipomoea series Urceolatae* BTH. Fl. Austr. 4 (1869) 427.—Fig. 56.

Herbaceous or woody twiners, usually hairy. Leaves petioled, ovate to orbicular, often cordate at the base, entire to 3- or 5-lobed, herbaceous. Flowers in dense, axillary, sessile or shortly peduncled cymes. Bracts small, caducous. Sepals 5, subequal, herbaceous or subcoriaceous, acute or obtuse, hairy or glabrous. Corolla regular, rather small, yellowish-white, urceolate, with a shortly 5-lobed limb; midpetaline bands hairy outside. Stamens and style included. Filaments inserted near the base of the corolla, dilated in their basal portion into a large concave scale, arched over the ovary; pollen globular, spinulose. Disk large, annular or cupular. Ovary glabrous or hairy, 2-celled, each cell with 2 ovules. Style 1, very short; stigmas 2, capitate. Capsule 4-valved, with 4 or less glabrous or puberulous seeds.

Distr. Ca 10 spp. in tropical Africa, Asia, Australia, and Malaysia.

KEY TO THE SPECIES

- 1. Sepals ovate to lanceolate, acuminate or acute, 5-7½ mm long, herbaceous. 1. *L. binectariferum*
- 1. Sepals ovate to orbicular, obtuse or emarginate, 2-2½ mm long, margin membranaceous. 2. *L. urceolatum*

1. *Lepistemon binectariferum* (WALL.) O.K. Rev. Gen. (1891) 446; OOSTSTR. Blumea 5 (1943) 341.—*Convolvulus binectariferus* WALL. in ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 47.—*Lepistemon flavescens* BL. Bijdr. (1825) 722.—*Lepistemon wallichii* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 443.—*Nemodon* sp. GRIFF. Not. 4 (1854) 286.—Fig. 56.

KEY TO THE VARIETIES

- 1. Sepals with long patent fulvous or brownish hairs.
- 2. Ovary glabrous . . . var. *binectariferum*
- 2. Ovary hairy . . . var. *borneense*
- 1. Sepals with much shorter, less patent greyish hairs.
- 3. Ovary glabrous . . . var. *eymae*
- 3. Ovary hairy . . . var. *trichocarpum*

var. *binectariferum*.

Herbaceous twiner, 1-3 m high; stems densely patentely or retrorsely brown pilose. Leaves broadly ovate, 5-18 by 5-15 cm, deeply cordate at the base, acuminate and mucronulate at the apex; margin entire or irregularly dentate with one or more large teeth or shallowly to deeply 3-5-lobed, with acute or acuminate lobes; appressed-pilose on both sides, young leaves (occasionally also the

adult ones) nearly tomentose with a golden-brown tomentum; petiole 2½-16 cm, hairy like the stem. Flowers in few- to many-flowered, axillary, cymose clusters, much shorter than the petiole. Peduncle short or absent. Pedicels up to 7 mm, glabrous or sparsely pilose. Bracts small, caducous. Sepals subequal or the inner ones a little shorter, ovate to lanceolate, acuminate or acute, 5-7½ mm long, herbaceous, with long patent hairs outside; not or slightly enlarged in fruit. Corolla urceolate, 12-15 mm long, white or yellowish white; tube inflated, contracted above, shortly hairy above and on the midpetaline bands of the limb; limb patent with 5 short lobes. Scales at the base of the filaments concave, papillose outside. Disk 5-lobed. Ovary glabrous. Capsule globose to ovoid, 6-8 mm high, mucronate, 4- or less-seeded. Seeds 3-4 mm long, glabrous, black.

Distr. SE. Asia (Assam, Burma, Indo-China, Hainan); in Malaysia: Malay Peninsula, Sumatra, Java.

Ecol. Thickets, edges of secondary forests, waysides, occasionally in hedges, or as a weed in plantations, 25-1100 m.

Use. Acc. to BOERLAGE the root is edible (Palabuan Ratu).

Vern. *Akar bulu*, *akar santen*, Sum. W. Coast, *areuj bulu*, *wawalukan*, S, *samparkidung*, *bonglu*, *gamet kebo*, *tjaonan*, J.

var. *borneense* OOSTSTR. Blumea 5 (1943) 343.

As var. *binectariferum*, but the ovary hairy.

Distr. *Malaysia*: SE. Borneo, Moluccas (Ambon).

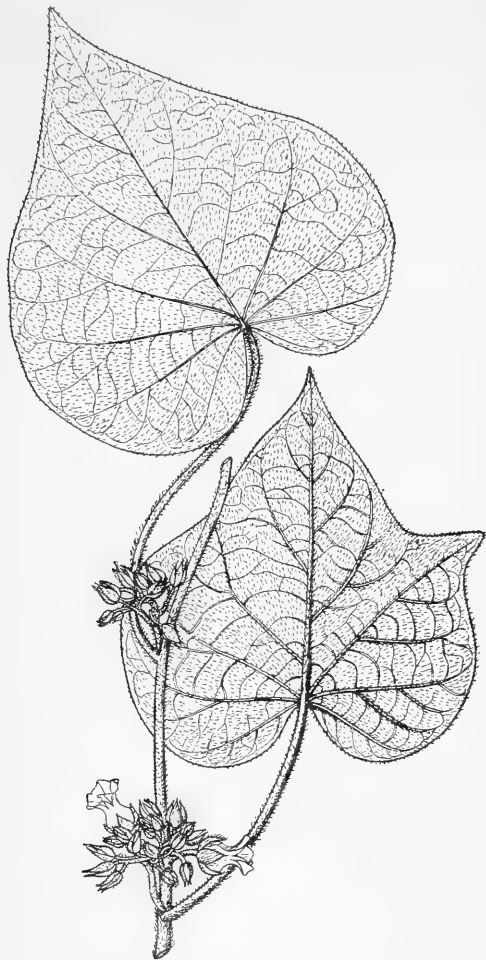


Fig. 56. *Lepistemon binectariferum* (WALL.) O. K.  
Flowering branch,  $\times 1/2$ .

var. *eymae* OOSTSTR. nov. var.<sup>1</sup>

Sepals with greyish, much shorter and less patent hairs than in var. *binectariferum*. Ovary glabrous.

Distr. *Malaysia*: E. Central Celebes.

(1) A var. *binectarifero* differt sepalorum pilis brevioribus minus patentibus. Ovarium glabrum: E. Central Celebes, between Tompantette and Lemo. EYMA 3990, fl. Oct. 1938, type in L, isotypes in A, Bo, K, U, SING.

var. *trichocarpum* (GAGNEP.) OOSTSTR. Blumea 5 (1943) 343.—? *Polemonium obscurum* BLCO, Fl. Filip. (1837) 103.—*Lepistemon flavescens* (non BL.) F.-VILL. Nov. App. (1880) 142.—*L. binectariferum* (non O.K.) MERR. Fl. Manila (1912) 383; Spec. Blanc. (1918) 321.—*L. trichocarpum* GAGNEP. Not. Syst. 3 (1915) 152.—? *L. obscurum* MERR. En. Philip. 3 (1923) 364.

Sepals with greyish, much shorter and less patent hairs than in var. *binectariferum*. Ovary hairy. Seeds puberulous (acc. to GAGNEPAIN).

Distr. *E. Malaysia*: Celebes, Moluccas (Kei Isl.), Philippines (Luzon, Mindanao), and ?Hainan.

Ecol. Thickets, waysides at low and medium altitudes.

Vern. Philippines: *baai*, Bon., *bangbangau-ñg-buduan*, Ilk., *pisu*, Ig.

2. *Lepistemon urceolatum* (R.Br.) F.v.M. Syst. Census Austr. Pl. (1882) 94; OOSTSTR. Blumea 5 (1943) 344.—*Ipomoea urceolata* R.Br. Prod. 1 (1810) 485.—*Lepistemon fitzalanii* F.v.M. Fragm. Phyt. Austr. 10 (1877) 111.—*L. lucae* F.v.M. Vict. Nat. 11 (1885) 74.—*L. asterostigma* K. SCHUM. Bot. Jahrb. 9 (1888) 216.—*L. sp.* K. SCHUM. l.c..

Stems twining, 2–5 m high, young parts densely hairy with retrorse hairs, later on glabrescent and woody. *Leaves* broadly ovate to orbicular, rarely narrower, 5–16 by 3–14 cm, cordate or more or less truncate at the base; basal lobes entire and broadly rounded, or with a large tooth or nearly hastate; acuminate and mucronulate at the apex; lower surface sparsely to densely hairy with short appressed hairs, or sometimes tomentose, upper surface mostly less hairy, glabrescent; petiole 3–11 cm, hairy like the stem. *Flowers* in few- or mostly in many-flowered, more or less dense, axillary, cymose clusters, much shorter than the petiole. Peduncle short or almost absent. Pedicels 3–7 mm, in fruit up to 14 mm, more or less pilose. *Sepals* subequal, slightly concave, broadly ovate to orbicular, obtuse or shallowly emarginate, 2–2½ mm long, hairy or glabrous. *Corolla* urceolate, 10–12 mm long, creamy white, glabrous outside or with some hairs in the upper part; tube inflated, contracted above; limb shortly 5-lobed. Scales at base of filaments smaller than in the preceding species, concave, shortly pilose outside. Disk shallowly 5-lobed. Ovary glabrous. *Capsule* globose, 8–10 mm diam. Seeds 4 mm long, puberulous, greyish-black.

Distr. Tropical Australia, Solomon Isl., Bismarck Arch., in *Malaysia*: Celebes, Moluccas (Talaud Islands, Buru, Ceram), New Guinea.

Ecol. In thickets and secondary forests, in more or less moist localities, 5–1250 m.

Vern. *Libuh-libuh*, S. Celebes, *kepi*, *onugo*, *arra*, NE. New Guinea, *a laklakisu*, New Ireland.

## 19. STICTOCARDIA

HALLIER f. Bot. Jahrb. 18 (1894) 159; OOSTSTR. Blumea 5 (1943) 346.—*Argyreia* sect. *Pomifera* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 184.—**Fig. 57.**

Woody or herbaceous, mostly pubescent twiners. *Leaves* petioled, ovate to orbicular, mostly cordate at the base, entire, the lower surface with many minute glands (black dots in dried specimens). *Flowers* in axillary, peduncled, one- to many-flowered cymes. Bracts small, caducous. *Sepals* 5, equal in length or slightly unequal, ovate, elliptic or orbicular, obtuse to emarginate, subcoriaceous, often with thinner margins, much enlarged in fruit. *Corolla* regular, large, funnel-shaped, red or purple; midpetaline bands often somewhat pilose outside and with minute glands like the leaves. *Stamens* and style included. Filaments filiform, inserted near the corolla-base; pollen globular, spinulose. Disk annular. *Ovary* glabrous, 4-celled, each cell with 1 ovule; style 1, simple, filiform; stigma biglobular. *Fruit* enclosed by the much enlarged calyx, globular; dissepiments with two wings at the surface of the fruit; pericarp thin, disrupting irregularly from the dissepiments and their wings, so that 4 openings become free (giving a lantern-shaped fruit), through which the 4 pubescent seeds are visible.

Distr. *Ca* 6-7 species, circumtropical.

## KEY TO THE SPECIES

1. Outer sepals distinctly cordate at the base, basal lobes up to 2 mm long . . . . . 4. *S. cordatosepala*
1. Outer sepals rounded at the base.
2. Sepals in anthesis 12 mm long or mostly longer. Corolla 8-10 cm long . . . . . 1. *S. tiliifolia*
2. Sepals in anthesis less than 12 mm long. Corolla smaller.
3. Stems, leaves and inflorescences very sparsely pubescent or glabrous. Leaves 8 cm long or more, long and narrowly acuminate at the apex, deeply cordate at the base . . . . . 3. *S. discolor*
3. Stems, leaves and inflorescences densely pubescent to tomentose. Leaves smaller, attenuate to slightly acuminate at the apex, more or less deeply cordate to truncate at the base. 2. *S. neglecta*

1. *Stictocardia tiliifolia* (DES.) HALLIER f. Bot. Jahrb. 18 (1894) 159 ('*tiliaefolia*'); OOSTSTR. Blumea 5 (1943) 346, f. 1, g-h.—*Ipomoea campanulata* LINNÉ, Sp. Pl. (1753) 160, only as to the syn. *Adamoea* RHEEDE (cf. VAN OOSTSTR. Blumea 3 (1940) 568).—*Convolvulus grandiflorus* LINNÉ f. Suppl. (1781) 136, non JACQ. 1776.—*Convolvulus tiliaefolius* DESR. in LAMK, Enc. 3 (1789) 544.—*Ipomoea grandiflora* LAMK, Tabl. Enc. 1 (1791) 467 (cf. VAN OOSTSTR. Blumea 3 (1940) 577).—*Ipomoea pulchra* BL. Bijdr. (1825) 716.—*Argyreia tiliaefolia* WIGHT, Ic. 4, 2 (1850) 12, t. 1358.—*Stictocardia campanulata* MERR. Philip. J. Sc. 9 (1914) Bot. 133.—*Argyreia campanulata* ALSTON in TRIM. Fl. Ceyl. Suppl. (1931) 201.—**Fig. 57c-f.**

A large woody twiner, young stems terete, pubescent, finally glabrescent. *Leaves* broadly ovate to orbicular, 6-20 by 5-20 cm, cordate at the base, shortly acuminate with a mostly obtuse, mucronulate apex; upper and lower surface more or less densely pubescent or nearly glabrous; lower surface with minute black dots (glands); nerves 7-8 on either side of the midrib; petiole 3-14 cm. *Inflorescences* axillary, 1-3-flowered; peduncle mostly shorter than the petiole, 1½-7½ cm, pubescent. Pedicels as long as or longer than the calyx, 10-35 mm, pubescent. Bracts minute,

caducous. *Sepals* orbicular with a rounded or shallowly emarginate apex, subequal or the inner ones slightly shorter, 12-18 mm long, pubescent or glabrous, much enlarged in fruit, and up to 4 or the inner ones up to 5 cm long. *Corolla* funnel-shaped, 8-10 cm long, reddish purple with a darker centre, limb 8-10 cm diam., midpetaline bands pilose or glabrous and with minute black glands. Filaments hairy at the base. *Ovary* glabrous. *Capsule* enclosed by the enlarged, finally weathered sepals, globose, 2-3½ cm diam. *Seeds* *ca* 8-9 mm long, black or dark brown, pubescent.

Distr. Circumtropical, throughout *Malaysia*, not yet recorded from N. Guinea.

Ecol. On and behind the seashore, in thickets, hedges, and secondary forests, sometimes also in the interior, up to *ca* 900 m.

Vern. *Areuj tatapajan gèdè*, S, *kabor*, Central Celebes, *halalei*, Ceram; Philippines: *bulðkan*, Tag., Sul., *burðkan-maputi*, S. L. Bis., *kal-kalauag*, Ilk., *tibulbùl*, Bik..

2. *Stictocardia neglecta* OOSTSTR. Blumea 5 (1943) 348, f. 1, i-j.

Stems twining, terete, densely short-pilose or the young parts tomentose, finally glabrescent and lignescent. *Leaves* ovate to broadly ovate, 4-8 by

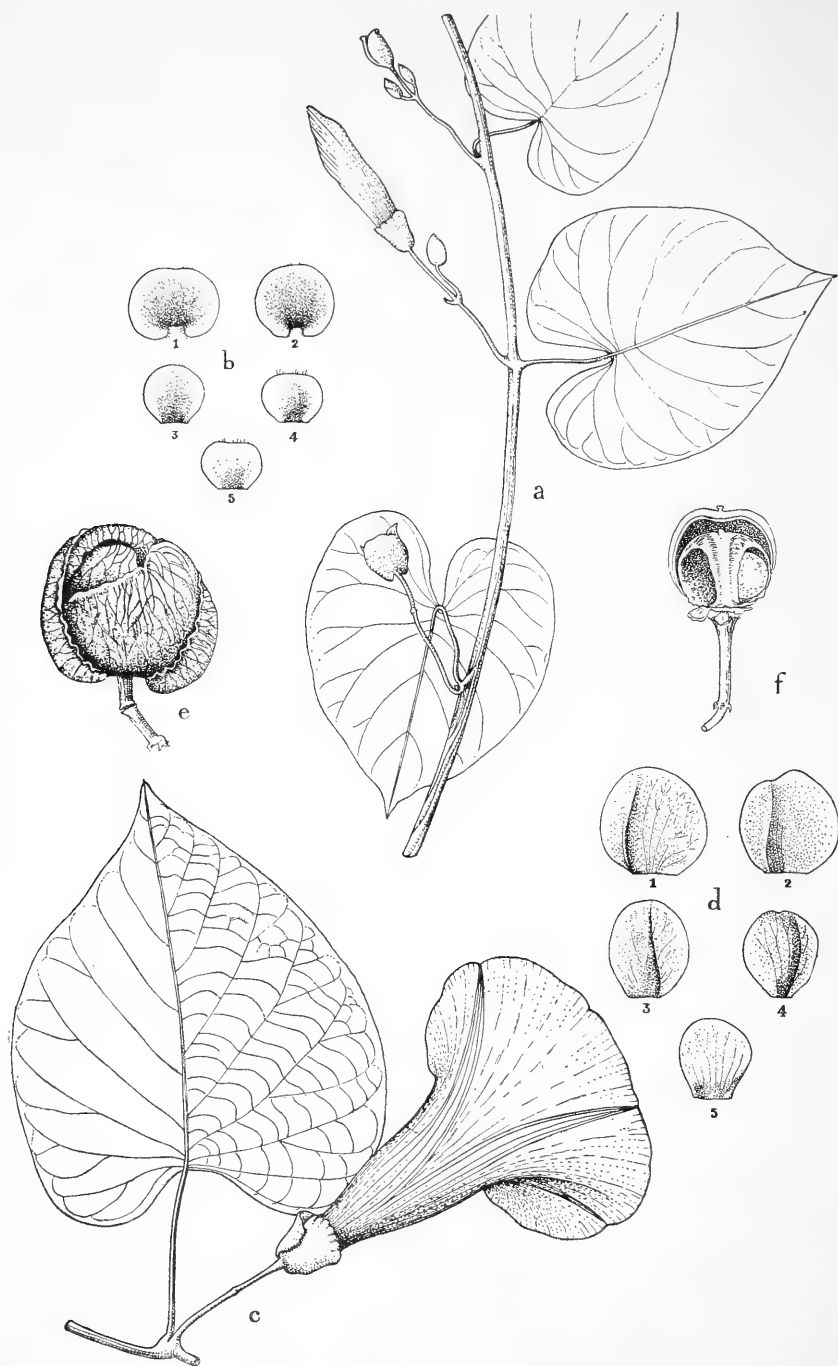


Fig. 57. *a-b. Stictocardia cordatosepala* OOSTSTR. *a.* Flowering branch,  $\times 1/2$ , *b.* sepals 1-5,  $\times 2/3$ .  
*c-f. Stictocardia tiliifolia* (DESR.) HALLIER *f. c.* flowering branch,  $\times 1/2$ , *d.* sepals 1-5,  $\times 4/5$ ,  
*e.* calyx enclosing the fruit,  $\times 1/2$ , *f.* fruit, opened, lateral view,  $\times 1/2$ .

3–7 cm, more or less deeply cordate or subtruncate at the base, attenuate to acuminate towards the acutish, mucronulate apex, densely short-pilose or the young ones tomentose on both sides, entirely green, or reddish beneath; nerves 7–8 on either side of the midrib; petiole 2–7 cm, shortly pilose. *Inflorescences* axillary, 1-flowered or cymosely branched, 2–4-flowered; peduncle  $1\frac{1}{2}$ –5 cm, in fruit up to 8 cm long, pilose like the stems. Pedicels (5–)10–18 mm, shortly pilose. Bracts minute, caducous. *Sepals* subequal in length or the outer ones slightly shorter, densely short-pilose to tomentose outside; two outer ones broadly ovate, elliptic or orbicular, shallowly emarginate at the apex, 8–11 mm long, three inner ones broadly elliptic, ca 10 mm long, the margins fimbriate towards the shallowly emarginate apex; all sepals much enlarged in fruit, up to  $3\text{--}3\frac{1}{2}$  cm long. *Corolla* tubular to funnel-shaped, ca 5–6 cm long, violet, darker to the centre, the limb shortly pilose outside. Filaments shortly pilose at the base. Ovary glabrous. *Capsule* enclosed by the enlarged sepals, subglobose, ca  $1\frac{1}{2}$  cm diam. Seeds 7–8 mm long, shortly tomentose.

Distr. *Malaysia*: SW. Celebes, Lesser Sunda Islands (Timor, Wetar).

Ecol. In thickets up to ca 900 m.

Vern. *Non laku, lololi*, Timor.

**3. *Stictocardia discolor* OOSTSTR.** *Blumea* 5 (1943) 350, f. 1, d–f.—*Ipomoea discolor* REINW. in sched.—*I. pulchra* BL. var. BL. Bijdr. (1825) 716.—*Stictocardia pulchra* HALLIER f. Bull. Herb. Boiss. 5 (1897) 380; *ibid.* 6 (1898) 548, as to the Timor specimens, *non Ipomoea pulchra* BL. 1825.

Stems twining, thin, slender, sparsely pubescent or glabrous. *Leaves* ovate, 8–15 by 4– $7\frac{1}{2}$  cm, base deeply cordate, apex acuminate, with long and narrow, obtuse or acutish, mucronulate acumen, sparsely and minutely pubescent on both sides, more densely on the nerves beneath, or nearly glabrous; lower surface reddish; nerves 7–10 on either side of the midrib; petiole 4–7 cm. *Inflorescences* axillary, 1–2-flowered; peduncle thin, 2–5 cm long, sparsely pubescent or nearly glabrous. Pedicels longer than the calyx, slender, 15–30 mm.

Bracts minute, caducous. *Sepals* subequal, 9–11 mm long, the outer ones orbicular to broadly elliptic, rounded at the apex, sparsely pubescent outside, shortly ciliate in the upper part; interior ones broadly elliptic. *Corolla* funnel-shaped, probably 6–8 cm long; midpetaline bands sparsely pilose outside and with minute black glands, or glabrous. *Capsule* unknown.

Distr. *Malaysia*: Lesser Sunda Islands (Timor).

Note. The species can be distinguished from *S. tillifolia* mainly by the much more slender stems and peduncles, the smaller flowers and the long-acuminate leaf-blades with a red lower surface.

**4. *Stictocardia cordatosepala* OOSTSTR.** *Blumea* 5 (1943) 351, f. 1, a–c.—Fig. 57a–b.

Stems twining, young parts shortly pilose, soon glabrescent to glabrous, afterwards lignescent. *Leaves* broadly ovate to orbicular, 6–12 by 5–12 cm, broadly cordate at the base, attenuate to shortly acuminate at the apex with an obtusish, mucronulate acumen, glabrous or nearly so and green above, glabrous or shortly pilose on the nerves, minutely glandular and reddish beneath; 6–7 nerves on either side of the midrib; petiole 3–9 cm. *Inflorescences* axillary, 1-flowered, or cymosely 2–3-flowered; peduncle 1–9 cm long, glabrous or shortly pilose mainly towards the apex. Pedicels 10–35 mm, sparsely short-pilose. Bracts oblong, obtuse, 3–5 mm long, caducous. *Sepals* slightly unequal in length; two outer ones orbicular to transverse-elliptic, 12 mm long, rounded to shallowly emarginate at the apex, cordate at the base with 2 mm long, fimbriate basal lobes; three inner ones orbicular, 8–9 mm long, rounded at the base, all sparsely pilose or glabrous, the shortly ciliate apex excepted. *Corolla* funnel-shaped, probably ca 6 cm high, violet; midpetaline bands with minute glands outside; margin fimbriate. Filaments shortly pilose at the base. Ovary glabrous. *Capsule* unknown.

Distr. *Malaysia*: Lesser Sunda Islands (Lombok).

Ecol. In thin forest, on loamy soil, 350–700 m.

Note. Distinguished by the remarkably cordate base of the sepals.

## 20. TURBINA

RAFINESQUE, Fl. Tellur. 4, 1836 (1838) 81.—*Legendrea* WEBB & BERTH. Hist. Nat. Iles Canar. Bot. 3, 2 (1844) 26, t. 137.

A genus closely related to *Ipomoea*, different by the indehiscent ovoid-oblong fruits, with a thin woody pericarp. Seed mostly 1, puberulous. Sepals narrow-ovate to oblong, obtuse, in fruit not or slightly enlarged, spreading, with a thick central part and thinner, pale margins.

Distr. Two spp. (or probably more, still under *Ipomoea*) in tropical America.

**1. *Turbina corymbosa* (L.) RAF.** Fl. Tellur. 4, 1836 (1838) 81.—*Convolvulus corymbosus* LINNÉ, Syst. ed. 10 (1759) 923.—*Convolvulus sidaefolius* H.B.K. Nov. Gen. 3 (1818) 99.—*Ipomoea sidaefolia* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 459.—*Rivea corymbosa* HALLIER f. Bot. Jahrb.

18 (1894) 157; MERR. En. Philip. 3 (1923) 371.—*Legendrea corymbosa* OOSTSTR. *Blumea* 5 (1943) 355.

A herbaceous or subwoody, mostly glabrous twiner. *Leaves* mostly ovate, 3–10 by 2–7 cm, cordate at the base, acuminate at the apex, entire;

petiole  $1\frac{1}{2}$ –7 cm. *Flowers* in few- to many-flowered axillary, 2–10 cm peduncled cymes, often united into panicles. Pedicels as long as the calyx or longer,  $1$ – $1\frac{1}{2}$  cm. Bracts minute. *Sepals* narrow-ovate to oblong, obtuse, inner ones 10–12 mm long, outer shorter, all with a thinner pale margin, spreading and not or slightly enlarged in fruit. *Corolla* campanulate, ca 2–3 cm long, white, with a yellowish centre, glabrous or sparsely pilose on

the distinctly limited midpetaline bands. *Stamens* and style included. Ovary glabrous. *Fruit* ovoid-oblong, ca 1 cm long, mucronate by the style-base. Seed mostly 1, ca 5 mm long, puberulent.

*Distr.* Tropical America, introduced here and there in the Old World, in *Malaysia* naturalized in the Philippines (Luzon).

*Ecol.* Thickets and secondary forests, at low altitudes.

## 21. ARGYREIA<sup>1</sup>

LOUR. Fl. Coch. (1790) 134; OOSTSTR. Blumea 5 (1943) 352; 5 (1945) 686; 6 (1950) 337; 7 (1952) 171; HOOGL. Blumea 7 (1952) 179.—*Lettsomia* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 75.—*Moorcroftia* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 431.—*Rivea* CHOISY, l.c. 407, emend. HALLIER f., p.p., type species excluded.—Fig. 58–61.

Mostly woody twiners. *Leaves* petioled, variable in shape and size, entire, hairy to glabrous. *Inflorescences* axillary, cymose, few- to many-flowered, loose or compact to capitate; bracts minute or large; flowers large, medium-sized, or small. *Sepals* 5, herbaceous or subcoriaceous, variable in shape and size, often hairy outside, mostly glabrous inside, persistent, slightly or sometimes much enlarged in fruit, in the latter case often red inside. *Corolla* regular, campanulate, funnel-shaped, or tubular, purple, red, pink, or white; limb nearly entire to deeply lobed, with 5 well-defined, mostly hairy midpetaline bands outside and glabrous connecting fields; in deeply lobed corollas the lobes consisting of a hairy midpetaline band with 2 narrow glabrous wings over the whole length, or with 2 glabrous lobules at the top. *Stamens* 5, inserted on the corolla, included or exserted; filaments filiform, often dilated at the base; pollen globular, spinulose. Disk annular or cupular, entire or shallowly 5-lobed. *Ovary* 2- or 4-celled, 4-ovuled, glabrous or hairy; style 1, simple, filiform, included or exserted; stigma biglobular. *Fruit* an ellipsoid or globose, fleshy, leathery, or mealy berry, purplish, red, orange, or yellowish. *Seeds* 4 or less, glabrous, rarely pilose at the hilum.

*Distr.* A genus of ca 90 species in tropical continental Asia, and in *Malaysia*; one sp. [*A. soutteri* (BAILEY) DOMIN] in Queensland. *A. queenslandica* DOMIN, also described from Queensland, belongs to *Stictocardia*. Fig. 59.

*Note.* For a discussion of the delimitation of the genus against *Rivea* and the inclusion in it of *Lettsomia* and *Moorcroftia*, see Blumea 5 (1943) 353–356.

### KEY TO THE SPECIES<sup>2</sup>

1. Limb of corolla entire or shallowly lobed (*sect. Ptyxanthus* G. DON).
2. Bracts soon caducous, small or rarely large, occasionally a casual foliaceous bract in the cyme.
3. Leaves deeply cordate at the base, densely white-tomentose beneath, glabrous or nearly so above.  
Bracts large and broad, outer ones ovate to oblong or elliptic, long and narrowly acuminate. 7. *A. nervosa*
3. Leaves not deeply cordate at the base. Bracts smaller to minute.
4. Corolla glabrous outside.
5. Inner sepals broadly ovate. Corolla ca  $5\frac{1}{2}$  cm long. Minor nervation of leaves distinctly reticulate beneath. Peduncles 5–7 cm long, on leafy branches . . . . . 14. *A. linggaensis*
5. Inner sepals elliptic-orbicular. Corolla ca  $3\frac{1}{2}$  cm long. Minor nervation subparallel, not distinctly reticulate. Peduncle  $1$ – $2\frac{1}{2}$  cm long, on defoliate branches . . . . . 13. *A. nuda*

(1) With the collaboration of R. D. HOOGLAND.

(2) Flowers of 42. *A. celebica*, 43. *A. crispa*, 44. *A. paucinervia*, 45. *A. samarensis* are unknown. 46. *A. robinsonii* is also insufficiently known. These species are, therefore, not inserted in the key.

- 4. Corolla with hairy midpetaline bands.
- 6. Outer sepals lanceolate or narrowly lanceolate, distinctly acute.
- 7. Outer sepals patently hirsute. Leaves elliptic or elliptic-oblong. Corolla *ca* 2 cm long. 15. *A. adpressa*
- 7. Outer sepals thinly white sericeous. Leaves broadly ovate to orbicular. Corolla *ca* 7 cm long. 16. *A. hookeri*
- 6. Outer sepals oblong, ovate or elliptic, obtuse, rarely acutish, not patently hirsute.
- 8. Lower surface of leaves covered by a dense haircloth.
- 9. Sepals equal or subequal in length.
- 10. Stamens and style much shorter than corolla; corolla 5 cm long or more. Lower surface of the leaves densely sericeous, silvery white or pale fulvous . . . . . 1. *A. mollis*
- 10. Stamens and style about as long as or longer than corolla; corolla smaller, *ca* 3 cm long or less.
- 11. Outer sepals broadly elliptic. Lower leaf-surface densely pubescent to tomentose with short, curled hairs, upper surface glabrescent . . . . . 5. *A. walshae*
- 11. Outer sepals ovate or oblong. Leaves appressed-sericeous above, sericeo-tomentose beneath. 6. *A. sumbawana*
- 9. Outer sepals distinctly longer than inner ones.
- 12. Outer sepals 8–9 mm long, oblong, obtuse or slightly emarginate, shortly tomentose on both sides. Peduncles much exceeding the petioles . . . . . 3. *A. bifrons*
- 12. Outer sepals 12–18 mm long, oblong, acutish or obtusish, sericeo-tomentose outside, glabrous inside except for the apical portion. Peduncles as long as or shorter than the petioles. 4. *A. nitida*
- 8. Lower surface of the leaves glabrous or sparingly strigillose.
- 13. Outer sepals (10–)15–18 mm long. Peduncles much shorter than the petioles. Corolla 4–4½ cm long . . . . . 2. *A. reinwardtiana*
- 13. Outer sepals at most up to 10 mm long. Peduncles usually longer than the petioles (if shorter: corolla up to 2½ cm long and outer sepals *ca* 4 mm long; see 8. *A. philippinensis*).
- 14. Two inner sepals cucullate, afterwards (always?) deeply emarginate by tearing of the apex; two outer sepals slightly longer than inner ones . . . . . 12. *A. cucullata*
- 14. Inner sepals not cucullate, afterwards not emarginate; two outer sepals equal to or slightly shorter than inner ones.
- 15. Filaments entirely glabrous.
- 16. Sepals all broadly ovate, at least the two outer ones sparsely strigose outside. Peduncles slender . . . . . 10. *A. penangiana*
- 16. Two outer sepals broadly ovate, two inner ones transverse-elliptic, all densely and shortly appressed-pilose to tomentose outside. Peduncles stout . . . . . 11. *A. scortechinii*
- 15. Filaments pilose at the base or glandular-papillose throughout.
- 17. Filaments pilose at the base only. Peduncles short, 1½–2 cm. Sepals *ca* 4 mm long, outer ones with some scattered hairs on their middle portion or glabrous. 8. *A. philippinensis*
- 17. Filaments glandular-papillose throughout. Peduncles longer. Sepals 6–6½ mm long, outer ones sparsely appressed-pilose . . . . . 9. *A. pedicellata*
- 2. Bracts persistent, large.
- 18. Sepals with long, hirsute acumens, the latter at least as long as the lower part of the sepal. 18. *A. maingayi*
- 18. Sepals at the apex obtuse, acute or shortly acuminate.
- 19. Outer bracts transverse-elliptic. Peduncles very slender . . . . . 21. *A. sphaerocephala*
- 19. Outer bracts elliptic or ovate to narrowly lanceolate. Peduncles stouter.
- 20. Outer sepals 15 mm long or more, lanceolate to ovate-oblong, acuminate, long patently hirsute. 17. *A. capitata*
- 20. Outer sepals 8 mm long or less.
- 21. Outer sepals ovate, obtuse or shortly apiculate, densely appressed-pilose outside. 20. *A. sorsogonensis*
- 21. Outer sepals ovate, sharply acute to acuminate, glabrous or more or less appressed-pilose outside . . . . . 19. *A. ridleyi*
- 1. Limb of corolla distinctly 5-lobed to 5-parted (*sect. Schizanthus* G. Don).
- 22. Lobes of corolla ovate to oblong, outside with a more or less hairy midpetaline band and with a thin glabrous wing on each side along the whole length.
- 23. Inflorescences capitate, with obovate to spatulate or orbicular, truncate, outside densely tomentose, subsistent bracts. Flowers sessile or nearly so. Stems, lower leaf-surface and inflorescences white, greyish or pale brown tomentose . . . . . 35. *A. osyrensis*
- 23. Inflorescences not capitate. Bracts mostly soon caducous. Flowers pedicellate. Indumentum of stems and leaves whether or not tomentose.
- 24. Two outer sepals ovate to orbicular, two inner ones broader, orbicular to transverse-elliptic.
- 25. Leaves strigillose above.



26. Leaves with a minute crisped pubescence beneath. Pedicels 1–2 mm long. Corolla-tube  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm, lobes  $5\frac{1}{2}$ –6 mm long . . . . . 34. *A. cinerea*
26. Leaves sparsely strigose beneath, with straight, appressed hairs.
27. Pedicels  $2\frac{1}{2}$ –5 mm long. Corolla-tube 4–5, lobes 8–10 mm long. Venation indistinct on both surfaces. Younger branches densely strigose . . . . . 32. *A. micrantha*
27. Pedicels 7–9 mm long. Corolla-tube ca  $7\frac{1}{2}$ , lobes ca 10–15 mm long. Venation distinct on both surfaces. Younger branches sparsely strigose . . . . . 22. *A. reticulata* var. *microcalyx*
25. Leaves glabrous above, usually sparsely strigose on midrib.
28. Leaves glabrous on both sides or nearly so. Inflorescences up to 6-flowered. 30. *A. parviflora*
28. Leaves distinctly hairy beneath. Inflorescences usually more-flowered.
29. Outer sepals 6–7 mm long, densely light fulvous-tomentose, as are the whole inflorescences. . . . . 29. *A. rubicunda*
29. Outer sepals up to ca  $4\frac{1}{2}$  mm long, strigose as are the whole inflorescences.
30. Corolla-lobes ca 5 mm long, ovate . . . . . 28. *A. kunstleri*
30. Corolla-lobes ca 15 mm long, ovate-oblong.
31. Outer sepals ca  $4\frac{1}{2}$  mm long, like the rest of the inflorescence densely strigose with long, stiff hairs. Lower leaf-surface strigose, green . . . . . 31. *A. erinacea*
31. Outer sepals ca  $3\frac{1}{2}$  mm long, like the rest of the inflorescence strigose-tomentose, with much shorter, less stiff hairs. Lower leaf-surface with less stiff, less appressed, slightly curved hairs, purple . . . . . 33. *A. discolor*
24. Two outer sepals broadly ovate to ovate-oblong, inner ones not distinctly different in shape.
32. Filaments entirely glabrous.
33. Corolla-lobes ca 4 mm long, ovate. Outer sepals broadly ovate, rounded at the apex. Corolla hairy inside above the base of the stamens. Leaves ovate . . . . . 23. *A. ooststroonii*
33. Corolla lobes ca 9 mm long, ovate-oblong. Outer sepals ovate-triangular, attenuate towards the apex. Corolla glabrous inside. Leaves oblong to narrow-oblong, with subparallel margins. . . . . 25. *A. oblongifolia*
32. Filaments with hairs or stalked glands at the base, or over their whole length.
34. Lateral nerves 10–11 on either side of midrib. Both surfaces of leaves strigose, more densely beneath than above . . . . . 26. *A. glabra*
34. Lateral nerves 7 or less on either side of midrib.
35. Lower surface of leaves densely light yellowish sericeous. Peduncle short, up to 2 cm long; up to 5-, usually 1-flowered . . . . . 24. *A. corneri*
35. Lower surface of leaves sparsely strigose to glabrous. Peduncle mostly longer; 3–20-flowered.
36. Minor nervation distinctly prominent beneath. Lateral nerves 4–5 on either side of midrib. Outer sepals sparsely strigose outside, ca  $7\frac{1}{2}$  mm long . . . . . 22. *A. reticulata* var. *reticulata*
36. Minor nervation much less prominent beneath, almost flat. Lateral nerves 6–7 on either side of midrib. Outer sepals densely greyish or whitish appressed-pilose outside, 5–6 mm long. . . . . 27. *A. luzonensis*
22. Lobes of corolla linear, hairy outside and with 2 glabrous lobules at the apex only.
37. Outer sepals distinctly acuminate . . . . . 37. *A. caudata*
37. Outer sepals obtuse, at most minutely apiculate.
38. Upper surface of leaves distinctly hairy.
39. Bracts lanceolate or narrower, acuminate, pubescent on both sides . . . . . 39. *A. barnesii*
39. Bracts broadly obovate, rounded to truncate at the apex, glabrous inside. . . . . 41. *A. congesta*
38. Upper surface of leaves glabrous or at most with some hairs on the midrib.
40. Bracts linear to filiform, 8–12 mm long, soon caducous. Leaves glabrous above; sparsely appressed-pilose beneath. Filaments papillose at the base . . . . . 40. *A. apoensis*
40. Bracts minute, 1–2 mm long, soon caducous.
41. Both surfaces of leaves glabrous or with some hairs on the nerves beneath. Outer sepals slightly longer than inner ones. Filaments pubescent . . . . . 38. *A. bohollensis*
41. Lower surface of leaves more or less densely appressed-pilose; upper surface glabrous or with some hairs on the midrib. Outer sepals slightly shorter than inner ones. Filaments glabrous. . . . . 36. *A. pseudorubicunda*

### 1. Section *Ptyxanthus*

G. DON, Gen. Syst. 4 (1838) 254.—*Argyreia* sect. *Samudra* ENDL. Gen. Pl. (1839) 655.

Corolla entire or shallowly lobed. Stamens and style mostly included.

1. *Argyreia mollis* (BURM. f.) CHOISY, Mém. Soc. Phys. Genève 6 (1833) 421; OOSTSTR. Blumea 5 (1943) 357; HOOG. Blumea 7 (1952) 180.—*Convolvulus sericeus* LINNÉ, Mant. 1 (1767) 43,

non BURM. f. 1768, nec *A. sericea* DALZ. & GIBS. 1861.—*Convolvulus mollis* BURM. f. Fl. Ind. (1768) 44, t. 17.—*A. obtusifolia* (non LOUR.) PRAIN, J. As. Soc. Beng. 74, 2 (1906) 320.—*Ipomoea sericea*

BL. Bijdr. (1825) 720.—*A. argentata* MIQ. Fl. Ind. Bat. 2 (1857) 588.—*A. championi* (non BENTH.) PRAIN l.c. 63, 2 (1894) 89.—?*A. obtecta* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 186.—*Lettsomia argentea* RIDL. J. Fed. Mal. St. Mus. 7 (1916) 47.—Fig. 58.

Stems twining, up to 10 m high; young parts densely appressed-pilose with whitish or pale fulvous hairs, glabrescent, occasionally more or less farinose. *Leaves* elliptic to narrowly oblong, sometimes ovate or lanceolate, 4–15 by  $1\frac{1}{2}$ –7 cm, base acute or attenuate into the petiole, or rounded; apex acute, shortly acuminate or obtuse, mucronulate, upper surface densely to sparsely appressed-hairy or glabrous, mostly with exception



Fig. 58. *Argyreia mollis* (BURM. f.) CHOISY.  
Flowering branch,  $\times \frac{1}{2}$ .

of the nerves; lower surface mostly densely sericeo-tomentose, with silvery white or pale fulvous hairs; nerves 9–18(–20) on either side of midrib; petiole 1–6 cm, appressed-pilose. *Peduncle* shorter to slightly longer than the petiole,  $\frac{1}{2}$ – $2\frac{1}{2}$ (– $4\frac{1}{2}$ ) cm, hairy, 1–5-, rarely more-flowered. *Pedicels* 5–15 mm, angular, hairy. *Bracts* obovate-oblong, obtuse, caducous. *Sepals* about equal in length, 2 outer ones broadly elliptic, obtuse, 8–10 mm long; sepal 3 and 4 elliptic to elliptic-oblong, obtuse to slightly emarginate; inner sepal oblong, slightly emarginate; all sepals densely sericeo-lanate outside, glabrous inside, in fruit enlarged, patent, red or purplish inside. *Corolla* funnel-shaped to campanulate, 5– $6\frac{1}{2}$  cm long, pale violet or pink with white base, or rarely entirely white; limb shallowly lobed; midpetaline bands with long, appressed hairs. *Stamens* and *style* much shorter than corolla; filaments pilose at the base. *Ovary* glabrous, 4-celled. *Fruit* subglobose, ca 8–10 mm diam., red or orange red, 4- or less-seeded. *Seeds* ca 5 mm long, black.

Distr. Siam, Lower Burma, Andaman Isl., in Malaysia: Sumatra, Malay Peninsula, Java, Madura, Kangean Arch., and Bali.

Ecol. In secondary forests, thickets, teak-forests, alang-fields, along roadsides, occasionally in hedges, from sea-level to 1500 m.

Use. In Java a decoction of the root, along with *Callicarpa*, *Anethum*, and *Alyxia* is taken as a stomachic. The leaves serve as a poultice for boils, etc. The stems are sometimes used for tying purposes (BURKILL; HEYNE).

Vern. *Areuj tatapajan*, *areuj kujapu*, *podol landak*, *tatajan gedé*, *kihui*, S, *këndal sapi*, *kemarang*, *kelawatan*, *rambatan*, *tulupan*, *uluk uluk*, J, *rabet po-sepo*, *sepo-sepoan*, Md, *butetutupan*, Bali.

Notes. Specimens from the Malay Peninsula cited by PRAIN under the names *A. obtusifolia* LOUR. and *A. championi* CLARKE certainly belong here. Most probably *A. obtecta* CLARKE belongs to the synonymy of the species; if so, the area would include Siam, Lower Burma, and the Andamans.

In most specimens from the Malay Peninsula the leaves are relatively narrower than in those from the Malay Islands.

2. *Argyreia reinwardtiana* (BL.) MIQ. Fl. Ind. Bat. 2 (1857) 589; OOSTSTR. Blumea 5 (1943) 360.—*Ipomoea reinwardtiana* BL. Bijdr. (1825) 720.—*A. guichenotii* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 423, excl. syn. *Ipomoea pulchra* BL.—*Convolvulus ovatus* REINW. ex CHOISY in DC. Prod. 9 (1845) 332, pro syn..

Stems twining; young parts sparsely pilose with short, appressed, whitish hairs, glabrescent. *Leaves* ovate, ovate-oblong, or elliptic-oblong,  $5\frac{1}{2}$ –17 by 3–10 cm; rounded, truncate, or subcordate at the base; attenuate or acuminate and mucronulate at the apex; upper surface glabrous or nearly so, lower surface sparsely to rather densely pilose with short, appressed, straight hairs; midrib and 8–10 nerves on either side prominent beneath, minor nervation reticulate beneath; petiole 2–5 cm, appressed-pilose. *Peduncle* distinctly shorter than the petiole, 1– $2\frac{1}{2}$  cm, rather densely pilose, 2- to few-flowered. *Pedicels* 3–5 mm, hairy like the peduncle. *Bracts* linear to oblong, 8–15 mm long, appressed-pilose beneath, glabrous or nearly so above, caducous. *Sepals* unequal, outer ones longer than inner, with  $\pm$  undulate margins; 2 outer ones ovate to orbicular, acutish to obtuse, (10)–15–18 mm long, outside densely sericeous, sometimes less densely so towards the apex, inside glabrous or nearly so; sepal 3 narrow-elliptic to ovate, obtuse, (7)–13 mm long; two inner sepals ovate-oblong, elliptic, or ovate, obtuse, (7)–8–9 mm long, densely whitish sericeous outside, sometimes with glabrous but ciliate margins; sepals enlarged in fruit, outer ones up to 20 mm long, red inside. *Corolla* funnel-shaped, ca 3– $4\frac{1}{2}$  cm long, purplish pink; limb shallowly lobed; midpetaline bands sericeous just as the upper portion of the tube. *Stamens* and *style* nearly as long as the corolla; filaments with pilose base. *Ovary* glabrous, 2-celled. *Fruit* depressed-globose (always?), 7–10

mm diam., 2-4-seeded. *Seeds* ca 5½ mm long (ripe?).

*Distr. Malaysia:* Lesser Sunda Islands (Timor).

*Ecol.* A specimen collected near Soë, S. Middle Timor, was growing between limestone rocks at 850 m.

*Note.* The type of *Ipomoea reinwardiana* Bl. has the outer sepals acutish at the apex, in other specimens they are sometimes partly or all obtuse to rounded. It is not impossible that the specimen from Timor mentioned by CHOISY under *A. setosa* CHOISY [Mém. Soc. Phys. Genève 6 (1833) 425; in DC. Prod. 9 (1845) 332] belongs to this species [See Blumea 5 (1943) 361].

**3. *Argyreia bifrons* OOSTSTR.** Blumea 5 (1943) 362, f. 2, t.

Stems twining; young parts densely pubescent to farinose. *Leaves* ovate, 5-10 by 3½-6½ cm; base truncate to emarginate, apex acute to shortly acuminate; upper surface densely and appressedly grey or olive-green sericeous, lustrous, lower surface densely and shortly crisped-tomentose, paler and dull; midrib and 10-14 lateral nerves on either side prominent beneath; petiole short, 1-2 cm, densely and shortly tomentose. *Peduncle* much exceeding the petiole, 6-10 cm, angular or sulcate when dry, shortly tomentose, umbellately cymose at the apex, many-flowered. *Pedicels* (of young flowers) up to 5 mm. *Bracts* oblong to narrowly spatulate, densely short-pubescent to tomentose on both surfaces, 6 mm long, caducous. *Sepals* unequal, densely pubescent to tomentose on both sides; two outer ones oblong, obtuse or slightly emarginate, 8-9 mm long, sepal 3 a little shorter and narrower, obtuse, ca 6½ mm long, two inner sepals broadly elliptic, obtuse, 5 mm long. *Corolla* funnel-shaped (only young flowers seen), bright violet, the midpetaline bands sericeous, for the rest glabrous. *Filaments* pilose at the base. *Ovary* glabrous, 2-celled. *Fruit* unknown.

*Distr. Malaysia:* Lesser Sunda Islands (Lombok).

*Ecol.* Twining on trees and shrubs; the only specimen known at 5-10 m.

*Note.* The young flowers of the type specimen do not permit a close examination of the corolla, stamens and pistil.

**4. *Argyreia nitida* (DESR.) CHOISY,** Mém. Soc. Phys. Genève 6 (1833) 424; OOSTSTR. Blumea 6 (1950) 339.—*Convolvulus nitidus* DESR. in LAMK, Encycl. 3 (1791) 544.—*A. mollis* (non CHOISY) MERR. Fl. Manila (1912) 386.—*A. purpuricarpa* ELM. Leaf. Philip. Bot. 5 (1913) 1766.

Stems twining, terete, appressed-hairy, glabrescent. *Leaves* oblong, narrowly ovate, ovate, or elliptic, 6-12 by 2½-9 cm, rounded at the base, acute and mucronulate at the apex, appressed-sericeous on both sides, but much more densely beneath than above, and silvery shining; nerves about 6-8 on either side of midrib; petiole much shorter than blade, 6-40 mm. *Peduncles* axillary, very much shorter than leaves, 5-10 mm long, densely appressed-pilose, 1-3-flowered. *Pedicels*

much shorter than sepals, 4-6 mm. *Bracts* of lateral flowers lanceolate, 3-4 mm long. *Sepals* unequal in length; two outer ones ca 12-18 mm long, oblong, acutish or obtusish, with more or less crisped margin, densely appressed-sericeo-tomentose outside, sparsely hairy near apex inside; sepal 3 falcate, ca 12 mm long; two inner sepals broad-ovate, acuminate, ca 9-10 mm long. *Corolla* funnel-shaped to campanulate, up to 8 cm long, pale purple with white throat; limb slightly lobed; midpetaline bands with long appressed hairs, connecting fields and basal portion of corolla glabrous. *Stamens* and *style* included; filaments pilose at the base. *Ovary* glabrous, 4-celled. *Fruit* globular, purplish-red, at its base with the patent, enlarged concave sepals, which are purplish red inside. *Seeds* 4, ca 5 mm long, glabrous except the pilose hilum.

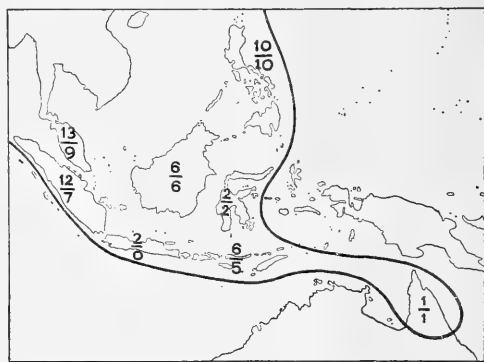


Fig. 59. Distribution of *Argyreia* in Malaysia. The figure above the line indicates the total number of species, the figure under the line that of endemic species.

*Distr. Malaysia:* Philippine Islands (Luzon, Culion, Panay, Palawan).

*Ecol.* In thickets and secondary forests at low and medium altitudes (MERRILL).

*Vern. Baging-kastila*, Tag., *bulakan*, *bulalakan*, P. Bis..

*Note.* Closely related to *A. mollis*; differs chiefly in the shape and size of the sepals with much shorter and more appressed hairs. *A. purpuricarpa* ELM. based on fruiting specimens from the island of Palawan, seems to be identical.

**5. *Argyreia walshae* OOSTSTR.** Blumea 5 (1943) 361, f. 2, n-p.

Stems twining, glabrous or sparsely short-pilose to farinose. *Leaves* broadly ovate or ovate, 5-16 by 2½-13 cm; base rounded or slightly emarginate, apex acute or slightly acuminate, mucronulate; upper surface sparsely appressed-pilose, glabrescent, lower surface densely pubescent to tomentose with short curled hairs; midrib and 9-12 lateral nerves on either side prominent beneath; petiole up to 10 cm long, shortly pubescent. *Inflorescences* umbellately-cymose, 4-12(-20)-flowered; peduncle

shorter than or as long as petiole, dirty white or greyish to fulvous tomentose as are the pedicels and the sepals outside. Pedicels 3–6 mm long, thickened at the apex. Bracts lanceolate to linear, tomentose beneath, glabrous above, caducous. *Sepals* subequal, broadly elliptic, obtuse, 6–8 mm long, outside tomentose, inside glabrous and brown. *Corolla* tubular to funnel-shaped, 2–2<sup>3</sup>/<sub>4</sub> cm long, the limb shallowly lobed; midpetaline bands and upper portion of tube sericeous. *Stamens* and *style* slightly exserted; filaments pilose at the base. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Lesser Sunda Islands (Timor).

Ecol. The type specimen has been collected at 800 m; according to the collector Mrs WALSH, the species is rather frequent in Timor.

6. *Argyreia sumbawana* OOSTSTR. *Blumea* 5 (1943) 362, f. 2, q–s.—*Rivea sumbawana* HALLIER f. in ELBERT, Sunda-Exp. 2 (1912) 281, *nom. nud.*

Stems twining, young parts densely appressed-pubescent to farinose, pale fulvous, adult parts farinose to glabrous. *Leaves* ovate, 6–13 by 3–8<sup>1</sup>/<sub>2</sub> cm; base slightly emarginate to truncate or shortly attenuate into the petiole, apex shortly acuminate, acute, and mucronulate; upper surface densely appressed-sericeous, lower surface densely and shortly sericeo-tomentose, pale fulvous; midrib and 9–14 lateral nerves on either side prominent beneath, slightly impressed above; petiole 2<sup>1</sup>/<sub>2</sub>–6 cm, densely and shortly pilose. *Peduncle* slender, exceeding the petiole, 3–11 cm, umbellately cymose at the apex, densely pubescent to farinose as are its branches and the pedicels. Pedicels 4–8 mm. Bracts minute, ovate-lanceolate, acute, densely pubescent outside, subglabrous inside, caducous. *Sepals* equal or the inner ones slightly shorter, outside densely pubescent, inside sparsely so to glabrous, two outer ones ovate-triangular, ovate-oblong, or oblong, obtuse, 5<sup>1</sup>/<sub>2</sub>–6<sup>1</sup>/<sub>2</sub> mm long; sepal 3 narrowly elliptic to oblong, slightly oblique, 5<sup>1</sup>/<sub>2</sub>–6<sup>1</sup>/<sub>2</sub> mm long; two inner sepals ovate to ovate-triangular, attenuate towards the obtuse apex, 5–6 mm long. *Corolla* tubular to funnel-shaped, ca 2<sup>1</sup>/<sub>2</sub> cm long, pink to pale reddish purple; limb shallowly lobed, soon reflexed; midpetaline bands and upper portion of tube sericeous. *Stamens* and *style* exserted. Filaments densely pilose at the base. Ovary glabrous, 4-celled. *Fruit* unknown.

Distr. *Malaysia*: Lesser Sunda Islands (Sumbawa).

Ecol. The species has been collected in dry thickets at 50 m and in open places at 500 m.

Note. The shape of the sepals appears to be rather variable. In the type specimen they are ovate-triangular to ovate-oblong, in other collections they are narrower.

7. *Argyreia nervosa* (BURM. f.) BOJ. Hort. Maurit. (1837) 224; OOSTSTR. *Blumea* 5 (1943) 364; *ibid.* 6 (1950) 338; HOOG. *Blumea* 7 (1952) 181.—*Convolvulus nervosus* BURM. f. Fl. Ind. (1768) 48, t. 20, f. 1.—*Convolvulus speciosus* LINNÉ f. Suppl. (1781) 137, *non ex Bras.*—*Ipomoea speciosa* PERS.

Syn. Pl. 1 (1805) 183.—*Lettsomia nervosa* ROXB. Fl. Ind. ed. CAREY & WALL. 2 (1824) 78.—*A. speciosa* SWEET, Hort. Brit. (1827) 289.—*Rivea nervosa* HALLIER f. Bull. Herb. Boiss. 5 (1897) 381.

Stems twining, up to 10 m high, densely whitish or fulvous tomentose, containing a milky viscid juice (WIGHT). *Leaves* large, ovate to orbicular, 10–30 cm or more by 8–25 cm or more, base deeply cordate, apex obtuse, acute or shortly cuspidate, mucronulate; upper surface glabrous or nearly so, lower surface densely white, greyish or fulvous sericeo-tomentose, shining; midrib and 11–16 nerves on either side prominent beneath, minor nerves many, parallel; petiole shorter than or as long as the blade, tomentose. *Flowers* in a subcapitate cyme at the end of a stout peduncle, this up to 20 cm long or longer, tomentose. Pedicels short, angular. Bracts large, ovate to oblong or elliptic, with long and narrow acumen, softly pilose outside, glabrous inside, 3<sup>1</sup>/<sub>2</sub>–5 cm long, caducous. *Sepals* equal in length or the inner ones slightly shorter, all densely whitish tomentose outside, glabrous inside. Two outer sepals broadly elliptic, obtuse or acutish, up to 15 mm long; three inner ones broadly elliptic to orbicular, obtuse, ca 10–12 mm long. *Corolla* large, tubular to funnel-shaped, ca 6 cm long, pink-purple; limb shallowly lobed; midpetaline bands and tube with exception of the most basal part densely sericeo-lanate outside. *Stamens* and *style* included. Filaments pilose at the base. Ovary glabrous, 4-celled. *Fruit* globose, apiculate, ca 2 cm diam., yellowish brown, nearly dry.

Distr. Native in India from Assam and Bengal to Belgaum and Mysore; cultivated in other tropical countries and occasionally escaped; in *Malaysia* cultivated as a garden plant.

Vern. *Areuj bohoh* kēboh, S, *hojas de seda*, *sedang-dahon*, Philip., *elephant creeper*, E.

8. *Argyreia philippinensis* (MERR.) OOSTSTR. *Blumea* 6 (1950) 341.—*Lettsomia philippinensis* MERR. Philip. J. Sc. 26 (1925) 488.

Stems twining, terete, longitudinally wrinkled in dry state, very sparsely appressed-pilose, glabrescent, pale greyish-brown. *Leaves* ovate to ovate-oblong, oblong-lanceolate or narrowly lanceolate, 7<sup>1</sup>/<sub>2</sub>–12<sup>1</sup>/<sub>2</sub> by (1<sup>1</sup>/<sub>2</sub>)–4–7 cm, rounded to truncate at the base, or in narrow leaves acute to cuneate; acuminate or attenuate towards the acute apex; glabrous on both sides except for a few scattered hairs, mainly along the nerves and especially beneath; nerves 5–7 on either side of the midrib; secondary nerves parallel; petiole 1<sup>1</sup>/<sub>2</sub>–6 cm, very sparsely pilose like the stems and the peduncles. *Peduncle* axillary, short, 1<sup>1</sup>/<sub>2</sub>–2 cm, cymosely branched at the apex, few-flowered. Pedicels 2<sup>1</sup>/<sub>2</sub>–5 mm, sparsely hairy. Bracts triangular, small, 1–2 mm long. *Sepals* about equal in length, ca 4 mm long; two outer ones ovate-elliptic; inner ones broader, all obtuse; outer ones with some scattered hairs on their middle portion or glabrous. *Corolla* tubular, ca 1<sup>1</sup>/<sub>2</sub>–2<sup>1</sup>/<sub>2</sub> cm long, white; limb very shortly lobed; midpetaline bands with appressed hairs outside, for the rest glabrous. Dilated

base of filaments with hairs along the margins. Ovary glabrous, 2-celled. *Fruit* ovoid, *ca* 12 mm long, on a pedicel 5–8 mm long.

Distr. *Malaysia*: Philippines (Luzon, Catanduanes Isl.).

Ecol. In damp forests at low altitudes (MERILL).

**9. *Argyreia pedicellata*** OOSTSTR. *Blumea* 5 (1943) 379, note, f. 2, h–j; *ibid.* 6 (1950) 340.

Stems twining, terete, pale greyish brown, lenticellate; young parts appressed-pilose, soon glabrous. *Leaves* oblong to ovate-oblong, 5–12 by 1½–6 cm, obtuse or acutish at the base, attenuate towards the obtusish or acute, mucronulate apex, or slightly acuminate, glabrous above except for the midrib, sparsely appressed-pilose and glabrescent beneath (occasionally densely hairy beneath); nerves 5–8 on either side of the midrib; petiole 1½–5 cm. *Peduncles* axillary, 5–10 cm, sparsely appressed-pilose, lenticellate, cymosely branched at the apex, few- to several-flowered. Pedicels sparsely appressed-pilose, more densely so near their base (occasionally hairy over the whole length), 7–12 mm, in fruit up to 25 mm long, at that time nodding, and slightly curved at the base, gradually thickened towards the apex. *Sepals* subequal or outer ones a little shorter; two outer sepals oblong to ovate-oblong, 6–6½ mm long, sparsely appressed-pilose; sepal 3 ovate, 6–6½ mm long, with one thin glabrous margin; two inner sepals broadly ovate to triangular, *ca* 7 mm long, with two glabrous margins. *Corolla* broadly funnel-shaped, white; limb subentire, *ca* 4½–5 cm diam.; midpetaline bands sericeous, connecting fields and basal portion of corolla glabrous. Filaments glandular-papillose throughout. Ovary glabrous, 2-celled. *Fruit* ellipsoid, up to 12 mm long, with 1 ellipsoid seed.

Distr. *Malaysia*: Philippines (Luzon).

Note. Specimens collected by Mrs CLEMENS (no 50) in Mindanao (Camp Keithley, Lake Lanao) in the U.S. Nat. Herb., *ditto* (s.n.) in Herb. Bog., formerly referred to this species (*cf.* *Blumea* 5, 1943, 379, note) appear to be specifically distinct; the specimens are too imperfect for a full description.

**10. *Argyreia penangiana*** (CHOISY) BOERL. *Handl. Fl. Ned. Ind.* 2 (1899) 513; HOOGL. *Blumea* 7 (1952) 181.—*Convolvulus penangianus* WALL. *Cat.* (1828) no 1425, *nom. nud.*—*Moorcroftia penangiana* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 406, t. 4.—*Lettsonia penangiana* MIQ. *Fl. Ind. Bat.* 2 (1857) 592.

Stems twining, to 3 m, sparsely strigose-hirsute when young, soon glabrescent. *Leaves* ovate to broadly lanceolate, 6–20 by 2½–11 cm, rounded or slightly cordate at the base, acute or slightly acuminate at the apex, upper surface glabrous, lower surface sparsely strigose when young, soon glabrescent; midrib and 7–8 nerves on either side prominent beneath, minor nervation usually inconspicuous; petiole slender, 1½–5 cm, hairy like the stem. *Peduncles* axillary, terete, very slender,

longer than the petioles, 2½–20 cm, sparsely strigose when young, soon glabrescent, cymosely (1–)3–15-flowered. Pedicels 5–15 (in fruit 20) mm long. Bracts linear-lanceolate, *ca* 5 mm long, slightly hirsute beneath, caducous. *Sepals* subequal, broadly ovate, *ca* 4–5 mm long; outer two with obtuse, inner three with rounded apex, strigose outside; sepal 3 with one, sepals 4 and 5 with two glabrous margins. *Corolla* funnel-shaped, *ca* 20–35 mm long, bright purple within, paler outside; tube broad, not manifestly distinct from upper part of corolla; limb subentire; midpetaline bands hirsute outside, connecting fields glabrous. *Stamens* and *style* included. Filaments dilated at the base, glabrous. Ovary glabrous, 2-celled. *Fruit* ovoid, *ca* 15 mm long, pink, 1-seeded.

Distr. *Malaysia*: Malay Peninsula (Perak, Pulau Penang).

Ecol. In forests from low altitude to 1700 m.

**11. *Argyreia scortechinii*** (PRAIN) HOOGL. *Blumea* 7 (1952) 182.—*Lettsonia scortechinii* PRAIN, *J. As. Soc. Beng.* 63, 2 (1894) 98.

Stems twining, to 4 m, rather densely and shortly strigose or strigose-hirsute to nearly glabrous. *Leaves* ovate to broadly ovate, 4–11 by 2½–7 cm, rounded or slightly cordate at the base, acute to slightly acuminate at the apex; upper surface glabrous, lower surface strigose-hirsute, most densely so on midrib and nerves, to nearly glabrous; midrib and 6–7 nerves on either side prominent beneath; minor nervation reticulate, rather distinct beneath; petiole slender, 1–4½ cm, hairy like the stem. *Peduncles* axillary, terete, 2–15 cm, hairy like the stem, but slightly more densely so, cymosely 2–25-flowered. Pedicels *ca* 3 mm long, in fruit up to 1 cm, hairy. Bracts triangular, *ca* 3 mm long, hirsute beneath, caducous. Two outer *sepals* broadly ovate, with rounded apex, *ca* 5–5½ mm long, densely and shortly appressed-pilose outside; two inner ones transverse-elliptic, *ca* 5½–6 mm long, with two broad glabrous margins, sepal 3 with one glabrous margin. *Corolla* funnel-shaped, *ca* 25 mm long; pale pink to nearly white outside, mauve or deep magenta inside; tube not distinct from upper part; limb shallowly lobed; midpetaline bands hirsute, connecting fields and basal portion of corolla glabrous. *Stamens* and *style* included. Filaments dilated at the base, glabrous. Ovary glabrous, 2-celled. *Fruit* ovoid, *ca* 1½ cm long, 1-seeded.

Distr. *Malaysia*: Malay Peninsula (Perak, Pahang).

Ecol. As far as known only at *ca* 1300–1500 m. Vern. *Akar tokal*, Mal. Pen.

**12. *Argyreia cucullata*** OOSTSTR. *Blumea* 5 (1943) 366, f. 2, k–m.

Stems twining, up to 5 m; young parts shortly hairy, later glabrescent to glabrous. *Leaves* ovate or narrowly elliptic, 4–10 by 2–6 cm, base rounded, apex acutish, obtuse or shortly acuminate, mucronulate, margins subrevolute; upper surface glabrous or with hairs on midrib; lower surface shortly pilose with laxly appressed hairs; midrib

and 6–8 nerves on either side prominent beneath; petiole 1–2(–6) cm, shortly pilose. *Peduncles* in the axils of the upper leaves, exceeding the petioles, 2–5(–15) cm, sparsely pilose to glabrous, sulcate or angular, umbellately cymose at the apex, many-flowered. Pedicels 2–3 mm, thickened towards the apex. Bracts oblong or linear, crisped, lower ones ca 1 cm (or longer, up to 2 cm), caducous. *Sepals* glabrous or sparsely short-pilose outside, 2 outer ones broadly ovate to ovate-oblong, not or slightly crisped, rounded (or obtuse) at the apex, with inflexed margins, ca 7–9(–10) mm long; sepal 3 broader, 5–6 mm long; 2 inner sepals ca 5–5½ mm long, strongly concave and cucullate, finally deeply emarginate at the apex (always?). *Corolla* campanulate to funnel-shaped, ca 3 cm long, violet, paler to white at the margin, shallowly lobed, lobes soon reflexed; midpetaline bands sub-hirsute, rest of corolla glabrous. *Stamens* and *style* included. Base of filaments thickened, glabrous. Ovary glabrous, 2-celled. *Fruit* ellipsoid, apiculate, ca 17 mm long, pink.

Distr. *Malaysia*: Sumatra, East Coast (Mt Sibajak, Petani Valley; Karo Uplands).

Ecol. Moist thickets, edges of virgin forests, 850–1300 m.

Note. A discussion of the variability is given in the original publication.

**13. *Argyreia nuda*** OOSTSTR. *Blumea* 5 (1945) 686, f. 1; *ibid.* 7 (1952) 172.

Stems twining, leafless at flowering-time, terete or slightly angular, with some appressed hairs in youth, glabrescent, more or less warty (lenticellate). *Leaves* ovate-oblong (or ovate), 11–15(–17) by 5–6(–12) cm, base rounded, in young leaves broadly cuneate, apex shortly acuminate; glabrous, the nerves excepted; midrib, ca 4(–6–7) nerves on either side and subparallel minor nervation prominent beneath; petiole up to 6(–10) cm long, shortly appressed-pilose, sulcate. *Inflorescences* in the axils of fallen leaves on the main stem or on lateral branches; in the first case umbellately cymose, 4–8- or up to 20-flowered, in the second case also umbellately cymose, and moreover contracted into a panicle. *Peduncles* 10–24 mm long, flattened towards the apex, appressed-pilose. Pedicels 4–7 mm or in the central flower up to 10 mm, at the base densely, towards the apex more sparsely pilose. *Sepals* glabrous or sparsely pilose at the base outside; two outer ones ovate, rounded or slightly retuse at the apex, ca 6 mm long; sepal 3 slightly oblique, elliptic-orbicular, ca 6–6½ mm long, with one thinner margin; two inner sepals elliptic-orbicular, ca 6½ mm long, with two thinner margins. *Corolla* funnel-shaped, ca 3½ cm long, glabrous outside, white, pink or violet towards the limb; limb shallowly lobed, ca 4–4½ cm diam. *Stamens* and *style* included. Filaments pilose at the base. Ovary glabrous, 4-celled. *Fruit* ovoid or ellipsoid, ca 12–14 mm long, violet or crimson.

Distr. *Malaysia*: N. half of Sumatra (Mt Taklamau, Upper Bila plain, Asahan).

Ecol. In forests, high climbing; flowers and

fruits in the basal parts of the stem; 600–900 m. Vern. *Akar katjan pariwo*, Mt Taklamau.

**14. *Argyreia linggaensis*** OOSTSTR. *Blumea* 7 (1952) 171.

Plant entirely glabrous, or with some appressed hairs in the leaf-axils and on the petioles and the nerves. Stems twining, branches terete or striate. *Leaves* oblong, ovate, or ovate-elliptic, 10–16 by 4–9 cm, rounded, truncate or slightly cordate at the base, acute to shortly acuminate, mucronulate at the apex; midrib, 5–7 arcuate nerves on either side of it, and reticulate minor nervation distinctly prominent beneath; petiole 2–6 cm, sulcate. *Peduncles* axillary, straight or curved, 5–7 cm, subangular, cymosely branched at the apex, 1–5-flowered. Pedicels 4–7 mm long. Two outer *sepals* ovate, acutish, ca 5 mm long; three inner ones slightly longer, up to 6 mm long, broadly ovate, obtuse, with thinner margins. *Corolla* funnel-shaped, ca 5½ cm long, glabrous outside, red; limb subtentire. *Stamens* and *style* included. Filaments shortly pilose at the base. Ovary glabrous. *Fruit* unknown.

Distr. *Malaysia*: Lingga Arch., Sumatra (East Coast).

Ecol. Edges of forests, 20–30 m.

Note. The leaves of the specimens from P. Singkep (Lingga Arch.) are ovate or ovate-elliptic; those of the Sumatran specimen are oblong.

**15. *Argyreia adpressa*** (CHOISY) BOERL. *Handl. Fl. Ned. Ind.* 2 (1899) 513; OOSTSTR. *Blumea* 5 (1943) 367; HOOGL. *Blumea* 7 (1952) 182.—*Convolvulus adpressus* WALL. *Cat.* (1828) no 1424, *nom. nud.*—*Moorcroftia adpressa* CHOISY, *Mém. Soc. Phys. Genève* 6 (1833) 431.—*Lettsomia adpressa* MIQ. *Fl. Ind. Bat.* 2 (1857) 591.

Stems twining, up to 20 m, young parts brown pilose to hirsute, glabrescent. *Leaves* elliptic or elliptic-oblong, 4–13 by 2–8 cm, base rounded or slightly cordate, apex obtuse or acutish to very shortly acuminate, more or less densely and loosely appressed-pilose to strigillose on both sides or upper surface more sparsely strigillose, the indumentum more or less shining, surface of older leaves more or less rough; midrib and 9–11 nerves on either side prominent beneath, nerves parallel, straight at first, curved near the margin; petiole 1½–5½ cm, hairy like the stem. *Peduncles* 2½–11 cm, hirsute; *flowers* at the end in a dense, capitate or umbelliform cyme with hairy branches. Pedicels 2–3 mm long, hairy. Bracts linear-lanceolate, acute, caducous. Two outer *sepals* linear-lanceolate, acute, 10–12 mm long, hirsute outside, glabrous or nearly so inside; three inner sepals shorter, lanceolate, gradually attenuate towards the apex, respectively 8–10, 6½–8 and 5½–7 mm long, hirsute outside but with glabrous margins, glabrous inside. *Corolla* funnel-shaped, 2–3 cm long, white with reddish purple bands; inside of throat and tube violet; limb almost entire; midpetaline bands with long, patent hairs, forming a kind of pencil in bud; rest of corolla glabrous. Filaments thickened and glabrous at the base. Ovary glabrous, 2-celled. *Fruit* ellipsoid, 16 by 12 mm, reddish

purple, at base with the irregularly spreading and reflexed sepals.

Distr. Siam, in *Malaysia*: Sumatra (East Coast), Malay Peninsula.

Ecol. In thickets and thin forests, 350–800 m.

**16. *Argyreia hookeri* CLARKE** in *HOOK. f. Fl. Br. Ind.* 4 (1883) 185.

Stems twining, robust, terete, greyish-strigillose. *Leaves* broadly ovate to orbicular, 8–18 by 8–18 cm, shallowly cordate to truncate at the base, shortly acuminate, mucronulate at the apex, glabrous or nearly so above, sparsely hairy beneath, more densely so on the nerves; midrib and 9–11 nerves on either side prominent beneath; minor nerves many, subparallel; petiole shorter than the blade, 4–7 cm, hairy like the stem. *Peduncles* 8–28 cm, hairy like the stem, cymosely branched at the apex with several to many flowers, the larger ones bearing below the terminal cyme 1 or 2 lateral ones in the axils of small, ovate to broadly ovate leaves. Pedicels shorter than sepals, 5–8 mm, terete, greyish appressedly hairy. Bracts lanceolate or oblong-lanceolate, attenuate towards the base, acute at the apex, lower ones 10–18 mm long. *Sepals* lanceolate, acute, with recurved top; three outer ones 10–12 mm long, inner ones ca 9 mm, thinly white sericeous outside and inside near the apex. *Corolla* tubular to funnel-shaped, ca 7 cm long, pink purple, dark purple inside; midpetaline bands hairy outside, rest of corolla glabrous. Filaments pilose at the base. Ovary glabrous, 4-celled.

Distr. From Nepal and Sikkim to Assam, Pegu and the Andamans, in *Malaysia*: in the neighbourhood of Bogor (Java) as an escape from the Botanic Gardens.

**17. *Argyreia capitata* (VAHL) CHOISY**, *Mém. Soc. Phys. Genève* 6 (1833) 423; OOSTSTR. *Blumea* 5 (1943) 368; HOOGL. *Blumea* 7 (1952) 184.—*Convolvulus capitatus* VAHL, *Symb. Bot.* 3 (1794) 28.—*Lettsomia strigosa* ROXB. *Fl. Ind. ed. CAREY & WALL.* 2 (1824) 80.—*Ipomoea trichotoma* BL. *Bijdr.* (1825) 717.—*Lettsomia capitata* MIQ. *Fl. Ind. Bat.* 2 (1857) 591.—*Lettsomia peguensis* CLARKE in *HOOK. f. Fl. Br. Ind.* 4 (1883) 193.—*Rivea capitata* HALLIER *f. Med. Rijksherb. Leiden* 1 (1911) 26.

Stems twining, up to 10 or 15 m high, young parts patently brown or fulvous hirsute, occasionally appressed-pilose with softer hairs. *Leaves* ovate to orbicular, rarely oblong-lanceolate, occasionally slightly contracted in the middle, 7½–18 by 4–13 cm, base shallowly to deeply cordate, apex acuminate; brown or fulvous-hirsute on both sides with patent to appressed hairs; nerves 13–18 on either side of midrib, straight at the base, curved near the margin; petiole slender, 5–16 cm long, mostly patently hirsute. *Peduncles* rather stout, 3–30 cm, patently hirsute. *Flowers* in a dense, capitate cyme. Bracts persistent, outer ones elliptic to narrowly lanceolate, acute at both ends, ca 1½–4 cm long, brown or fulvous-hirsute outside and at the margins, glabrous inside

except at the apex; upper bracts narrower. Pedicels very short or none. *Sepals* lanceolate or ovate-oblong to oblong, acuminate, patently hirsute outside; 3 outer ones 15–17 mm long, 2 inner ones 12 mm. *Corolla* funnel-shaped, 4½–5½ cm long, reddish purple, pale violet or pink, often paler without and towards base, rarely entirely white; limb subentire, midpetaline bands hirsute outside. *Stamens* and style included. Filaments glandular-pilose at the base, the corolla inside with long hairs between their bases. Ovary glabrous, 2-celled. *Fruit* globose, 8 mm diam., with leathery wall, orange red, reddish or brownish, 4- or less-seeded.

Distr. Bengal to Indo-China, southwards to Siam, the Andaman Islands, and *Malaysia*: Sumatra, Malay Peninsula, Java, Madura.

Ecol. Thickets, secondary forests, edges of forests, teak-forests, roadsides, open grounds, from sea-level to 1700 m.

Use. The stems are used as binding material for bundles of firewood (Sumatra: Karo Uplands).

Vern. *Akar tapah rusa*, *akar têmiang*, *akar ulan bukit*, *akar lana bulu*, Mal. Pen., *akar bulu* or *bubulu*, Sumatra, *areuj bulu*, *areuj bulu beureum*, *areuj ki bulu*, S., *kotong*, *djamet*, *klurak*, J. For more local names see *Blumea* 5 (1943) 370.

Notes. The density of hairiness varies considerably; mostly the hairs are rather stiff and bristly, sometimes they are softer, more silky and more or less appressed to the stems, petioles and leaf-surfaces. Such specimens are found in Sumatra as well as in Java and Madura; however, they seem to be more common in Sumatra. The shape of the bracts also greatly varies; the outer ones may be elliptic to narrowly lanceolate.

For a discussion of the synonyms *Lettsomia capitata*, *L. peguensis*, and *L. strigosa*, see *Blumea* 5 (1943) 370, and 7 (1952) 184.

**18. *Argyreia maingayi* (CLARKE) HOOGL.** *Blumea* 7 (1952) 185.—*Lettsomia maingayi* CLARKE in *HOOK. f. Fl. Br. Ind.* 4 (1883) 195.

Stems twining, patently fulvous-hirsute when young, later on glabrescent. *Leaves* ovate, rarely elliptic-oblong or obovate, 9–20 by 3½–11 cm; rounded at the base or shortly attenuate into the petiole, acuminate at the apex; upper surface glabrous or nearly so, lower surface strigose-hirsute on the nerves only; midrib and 5–6 nerves on either side prominent beneath, minor nervation reticulate, rather prominent beneath; petiole 1½–5 cm, sparsely patent- to appressed-hirsute. *Peduncles* axillary, stout, terete, 1½–5 cm long, patently hirsute, deeply longitudinally grooved when dry; flowers in a dense, capitate cyme at the end of the peduncle; diam. of capitulum 5–9, with the corollas up to 17 cm, in poorly developed specimens smaller. Outer bracts broadly ovate to narrowly lanceolate, obtuse to acute at the apex, rounded at the base, 2½–4 cm long, rather sparsely fulvous-hirsute to nearly glabrous outside and at the margins, glabrous inside; upper bracts smaller and narrower. Pedicels very short or none. *Sepals* ovate-oblong, long-acuminate, three outer ones 11–15 mm long, of which the



acumen 6-9 mm, long-hirsute outside, the basal part glabrous; two inner ones 9-13 mm long. *Corolla* funnel-shaped with distinct tube,  $4\frac{1}{2}$ -6 cm long, white with pink, red, crimson or purple stripe on the middle of each lobe; limb subentire, midpetaline bands hirsute, connecting fields glabrous. *Stamens* and *style* included. Filaments glandular-pilose at the base. Ovary glabrous, 2-celled. *Fruit* ovoid, ca 12 mm long, pink, 1-seeded.

Distr. *Malaysia*: Malay Peninsula.

Ecol. Jungle, swamps and edges of rivers, up to 1000 m.

Uses. The slightly sweet fruits are said to be edible; ALVINS states that a decoction of the roots may be used externally for pains in the bones.

Vern. *Akar bungah butang, akar sémulut, akar tērong tērong, akar ulan gajah, akar sapu utan, akar kēlupus, akar tentērong*, Mal. Pen.

Note. As is the case in *Argyreia ridleyi* and *A. capitata* the shape of the bracts varies a great deal; in some specimens they are narrowly lanceolate, 30 by 3 mm, but mostly they are broader, up to broadly ovate, with a relatively small number of intermediates.

**19. *Argyreia ridleyi* (PRAIN) PRAIN ex OOSTSTR.** *Blumea* 5 (1943) 370; HOOGL. *Blumea* 7 (1952) 185.—*Lettsomia ridleyi* PRAIN, J. As. Soc. Bengal 63, 2 (1894) 98.—*Lettsomia ridleyi* PRAIN var. *velutina* PRAIN, l.c. 99.

Stems twining, densely hairy with fulvous, appressed hairs. *Leaves* ovate or elliptic, or the upper ones elliptic-oblong,  $7\frac{1}{2}$ -18 by  $3\frac{1}{2}$ -13 cm, base rounded, or shortly attenuate into the petiole; apex acuminate to cuspidate, with a narrow, acute and mucronulate acumen; upper surface glabrous or nearly so, lower surface rather densely hairy with patent or loosely appressed hairs, more densely so on the nerves; midrib and 6-9 nerves on either side prominent beneath, minor nervation reticulate, rather prominent beneath; petiole  $2\frac{1}{2}$ -8 cm, hairy like the stem. *Peduncles* mostly shorter than or as long as the petiole, rarely longer, 1-18 cm, hairy like the stems; flowers in a broad, capitate, 8-10-flowered cyme. Bracts large, ovate to lanceolate, acuminate, 2-3 cm long, glabrous and purple inside, almost tomentose outside; upper bracts smaller and narrower. Pedicels very short. Two outer *sepals* ovate, sharply acute to acuminate, glabrous, hairy below the apex, or over the whole surface, 6-7 mm long, three inner ones elliptic to broad-elliptic, obtusish, ca  $5\frac{1}{2}$  mm long, glabrous; sepal 3 sometimes with a few hairs near the apex. *Corolla* funnel-shaped, ca 3 cm long, white or pinkish; limb shallowly lobed; midpetaline bands hirsute outside. Ovary glabrous, 2-celled. *Fruit* ovoid, ca 13 mm long, pink.

Distr. *Malaysia*: Malay Peninsula, Riouw and Lingga Archipelagos.

Ecol. In the Malay Peninsula locally in damp forests up to ca 600 m.

Vern. *Akar simpis, akar saga molek, akar tērong*, Mal. Pen..

Notes. PRAIN's var. *velutina* differs from 'var. *typica*' (PRAIN, l.c. 98) by its somewhat smaller

leaves and by being more densely hirsute. The differences do not make the impression to be of great importance, and may be due to differences in age or habitat.

**20. *Argyreia sorsogonensis* (ELMER) OOSTSTR.** *Blumea* 6 (1950) 340.—*Rivea sorsogonensis* ELM. Leaf. Philip. Bot. 10 (1939) 3721.

Stems twining, terete, solid, very sparsely pilose, light to dark brown. *Leaves* narrowly ovate to oblong, 7-15 by 3-6 cm, rounded at the base, gradually attenuate towards the acute, mucronulate apex, sparsely strigillose or glabrous above, subglabrous beneath or sparsely strigillose on the nerves; nerves ca 8 on either side of the midrib; petiole  $3\frac{1}{2}$ -7 cm, strigillose. *Peduncles* axillary, up to 18 cm long, strigillose. Flowers in a few-flowered cyme with long-persistent, oblong-lanceolate, acute, sparsely appressed-pilose, 15-22 mm long bracts, inserted at the base of the pedicels. Pedicels 2-3 mm long, densely appressed-pilose. *Sepals*  $7\frac{1}{2}$ -8 mm long; two outer ones ovate, obtuse or shortly apiculate, densely greyish appressed-pilose outside, glabrous inside; sepal 3 slightly broader, obtuse, with one glabrous margin; two inner sepals broad-ovate, obtuse, with two glabrous margins. *Corolla* funnel-shaped (only seen in bud); limb subentire, slightly undulate; midpetaline bands sericeous, connecting fields and basal portion of corolla glabrous. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Philippines (Luzon).

Ecol. In light woods among shrubberies at 300 m.

**21. *Argyreia sphaerocephala* (PRAIN) HOOGL.** *Blumea* 7 (1952) 183.—*Lettsomia sphaerocephala* PRAIN, J. As. Soc. Beng. 73, 2 (1904) 19.

Stems twining, terete, sparsely strigose. *Leaves* narrowly ovate, 5-10 by  $2\frac{1}{2}$ -4 cm, rounded at the base, acute or slightly acuminate at the apex, sparsely strigose on both sides; midrib and 5-6 nerves on either side slightly prominent beneath; petiole 1-3 $\frac{1}{2}$  cm, sparsely strigose. *Peduncles* axillary, thin, terete, up to ca 20 cm long,  $\frac{2}{3}$ -1 mm diam., sparsely strigose; flowers in a dense, ca 30-flowered capitate cyme. Pedicels 3-4 mm. Outer bracts transverse-elliptic, ca  $2\frac{1}{2}$  by 3 cm, hirsute outside, sparsely so inside, innermost bracts obovate-spathulate, ca 5 by 3 mm. *Sepals* ovate, ca 4 mm long, two outer ones obtuse, sepal 3 rounded, two inner ones retuse at the apex; outer sepals hirsute near the apex only, inner ones in the central part only. *Corolla* infundibuliform-campanulate (PRAIN),  $2\frac{1}{2}$  cm long (PRAIN), pink; limb probably subentire, midpetaline bands hirsute, connecting fields and lower portion of corolla glabrous. Filaments glabrous. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Malay Peninsula (Perak).

Note. The collections of this remarkable species only contain flower-buds. The species is easily recognized by the capitate inflorescences with large bracts at the end of the long and slender peduncle.



2. Section *Schizanthus*

G. DON, Gen. Syst. 4 (1838) 256.—*Argyreia* sect. *Euargyreia* ENDL. Gen. Pl. (1839) 655.

Corolla distinctly 5-lobed to 5-parted. Stamens and style mostly exserted.

**22. *Argyreia reticulata*** (PRAIN) HOOGL. *Blumea* 7 (1952) 190.—*Lettsomia penangiana* (CHOISY) MIQ. var. *reticulata* PRAIN, J. As. Soc. Beng. 63, 2 (1894) 99.

## KEY TO THE VARIETIES

1. Two outer sepals *ca* 7½ by 4 mm; two inner ones *ca* 7 by 5 mm, all broadly acute at the apex. var. *reticulata*
1. Two outer sepals *ca* 4 by 3 mm, broadly acute at the apex; two inner ones *ca* 4 by 4½ mm, rounded, mucronate at the apex. var. *microcalyx*

var. *reticulata*.

Stems twining, to 10 m, terete, sparsely strigose. *Leaves* ovate to broadly lanceolate, 5½–10 by 2½–4½ cm, obtuse to rounded at the base, slightly acuminate at the apex; upper surface sparsely strigose, glabrescent, lower surface sparsely strigose; midrib and 4–5 nerves on either side prominent beneath; minor nervation reticulate, rather conspicuous beneath; petiole slender, 1–3 cm, strigose. *Peduncle* axillary, terete, 2–9 cm long, strigose, cymosely 3–15-flowered. *Pedicels* *ca* 7–9 mm long. *Bracts* linear-lanceolate, *ca* 5 mm long, strigose beneath, caducous. *Sepals* ovate, two outer ones *ca* 7½ by 4 mm, two inner ones *ca* 7 by 5 mm, broadly acute at the apex, all sepals rather sparsely strigose, sepal 3 with one, two inner sepals with two broad glabrous margins. *Corolla* funnel-shaped, *ca* 20–25 mm long, waxy white, pale blue inside; tube distinct, *ca* 7½ mm long, glabrous; limb distinctly 5-lobed; lobes *ca* 10 mm long, midpetaline bands hirsute outside with a glabrous wing on either side along the whole length. *Stamens* and *style* about as long as corolla. Base of filaments dilated, with glandular hairs. *Ovary* glabrous, 2-celled. *Fruit* ovoid, *ca* 15 mm long, magenta, 1-seeded.

Distr. *Malaysia*: Malay Peninsula (Perak, Pahang, Selangor).

Ecol. In open bamboo-forest and in cleared places, 150–1400 m.

var. *microcalyx* HOOGL. *Blumea* 7 (1952) 191.

Differs from var. *reticulata* by the smaller calyx; two outer sepals *ca* 4 by 3 mm, broadly acute at the apex; two inner sepals *ca* 4 by 4½ mm, rounded, mucronate at the apex.

Distr. *Malaysia*: Malay Peninsula (Selangor).

Ecol. Forest-edges.

**23. *Argyreia oostroomii*** HOOGL. *Blumea* 7 (1952) 189, f. 1, a–g.

Stems twining, young parts fulvous-strigose with partly slightly patent hairs. *Leaves* ovate, 6–14 by 3½–8½ cm, rounded or slightly cordate at the base, acute or slightly acuminate at the

apex, upper surface glabrous, but sparsely strigose on midrib, lower surface strigose on midrib and lateral nerves, sparsely so on the intervenium; midrib and 5–8 nerves on either side prominent beneath, minor nervation reticulate, rather inconspicuous; petiole short, 1–4½ cm long, hairy like the stem. Upper inflorescences forming a rather lax panicle, composed of more or less long-peduncled cymes, leafless or with a few small leaves; lower ones axillary. *Peduncles* terete, longer than the petioles, 3–16 cm long, hairy like the stem, cymosely *ca* 25-flowered. *Pedicels* *ca* 3 mm long, hairy. *Bracts* ovate, *ca* 5 mm long, rounded, often shallowly split at the apex, hirsute beneath, caducous. *Sepals* subequal in form, broadly ovate, rounded at the apex, *ca* 4 mm long, fulvous-hirsute, sepal 3 with one, two inner sepals with two glabrous margins. *Corolla* funnel-shaped, *ca* 13 mm long, white, tube violet mauve, dark purple inside; limb distinctly 5-lobed, lobes ovate, *ca* 4 mm long; midpetaline bands hirsute with a glabrous wing on either side along the whole length, basal portion of corolla glabrous; inside sparsely hirsute above the base of the stamens. Filaments with dilated base, glabrous. *Ovary* glabrous, 2-celled. *Fruit* (unripe?) ovoid, *ca* 12 mm long, pink, 1-seeded.

Distr. *Malaysia*: Malay Peninsula (Kelantan and Trengganu).

Ecol. Edges of secondary forest.

**24. *Argyreia corneri*** HOOGL. *Blumea* 7 (1952) 192, f. 1, m–q.

Stems twining, to 15 m or more, terete, strigose. *Leaves* ovate, 3½–7 by 2–4 cm, obtuse or rounded at the base, acuminate at the apex; upper surface glabrous except the strigose midrib, lower surface densely light-yellowish sericeous; midrib and 5–6 nerves on either side prominent beneath, minor nervation reticulate, inconspicuous; petiole 1–2½ cm, strigose. *Peduncles* axillary, terete, short, 10–18 mm, densely sericeous, cymosely 1–5-flowered, usually 1-flowered. *Pedicels* *ca* 4–6 mm, sericeous. *Bracts* lanceolate, *ca* 4 mm long, sericeous, caducous. *Sepals* broadly ovate, broadly acute to rounded at the apex, densely sericeo-tomentose outside, one margin of sepal 3 and both margins of sepals 4 and 5 less densely hairy or partly glabrous; three outer sepals *ca* 8½ mm, two inner ones *ca* 6½ mm long. *Corolla* funnel-shaped, *ca* 2½ cm long, pale pinkish white outside, rose-pink inside; tube not distinct; limb distinctly 5-lobed, lobes ovate-oblong, *ca* 15 mm long; midpetaline bands hirsute upwards with a glabrous wing along the whole length, rest of corolla glabrous. Filaments dilated and glandular hairy at the base. *Ovary* glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Malay Peninsula (Pahang).

**25. *Argyrea oblongifolia* OOSTSTR.** Blumea 5 (1943) 376, f. 2, a-e.

Stems twining; young branches terete, very shortly greyish appressed-pilose, adult ones angular, glabrescent. *Leaves* oblong to narrowly oblong with subparallel margins, 5–10 by  $1\frac{1}{2}$ –3 cm; rounded at the base; attenuate towards the obtusish, mucronulate apex; chartaceous or thinly coriaceous, on both sides sparsely appressed-pilose in youth, soon glabrous; midrib prominent beneath; nerves 7–8 on either side hardly conspicuous; minor nervation inconspicuous; petiole  $1\frac{1}{2}$ –3 cm long, slender, shortly appressed-pilose. *Inflorescences* axillary, pilose like the branches; *peduncles* straight, patently erect,  $2\frac{1}{2}$ –7 cm long, umbellately cymose at the apex with 2–5 branches. Pedicels 2–3 mm. Bracts minute, occasionally a foliaceous bract in the cyme. *Sepals* subequal, shortly appressed-pilose outside; two outer ones ovate-triangular, three inner ones broadly ovate-triangular, all attenuate towards an acutish apex, *ca*  $3\frac{1}{2}$ –4 mm long; sepal 3 with one, sepals 4 and 5 with two glabrous margins. *Corolla* funnel-shaped, *ca* 15 mm long, deeply 5-lobed, white; tube *ca* 5–6 mm long, gradually widened towards the limb, glabrous; lobes oblong-ovate, *ca* 9 mm long; midpetaline bands sericeous outside, margins glabrous. Filaments glabrous. Ovary glabrous, 2-celled. *Fruit* ovoid, up to 15 mm long (mature?), nodding, reddish.

Distr. *Malaysia*: Borneo (W. Kutai).

Ecol. In primary forest, *ca* 1600 m.

**26. *Argyrea glabra* CHOISY** in ZOLL. Syst. Verz. 2 (1854) 128, 130; OOSTSTR. Blumea 5 (1943) 373, as to the name only; *ibid.* 7 (1952) 174.—*Rivea glabra* HALLIER f. Bull. Herb. Boiss. 6 (1898) 714.

Stems twining, shortly appressed-pilose. *Leaves* ovate, 5–8 by 2–4 cm; base rounded, apex acute; appressed-pilose on both sides with short, rigid hairs, more densely beneath than above; midrib and *ca* 10–11 nerves on either side prominent beneath; minor nerves indistinct beneath; petiole  $1\frac{1}{2}$ –2 cm, pilose like the stems. *Peduncles* in the upper leaf-axils, angular, *ca* 5 cm long, densely appressed-pilose with short, fulvous hairs, as are the branches of it and the pedicels, umbellately cymose, few- to several-flowered. Pedicels up to 5 mm long. Bracts ovate, obtuse, *ca* 4–5 mm long, densely appressed-pilose. *Sepals* densely appressed-pilose with fulvous hairs; three outer ones ovate-elliptic, obtuse, *ca* 6 mm long; two inner ones ovate, rounded, a little shorter. *Corolla* 5-fid; tube at least 10 mm long, widened above, glabrous; lobes ovate, *ca* 15 mm long, patent to reflexed; midpetaline bands sericeous. Filaments dilated and densely pilose at the base. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Lesser Sunda Islands (Lombok).

Ecol. In forests.

**27. *Argyrea luzonensis* (HALLIER f.) OOSTSTR.** Blumea 5 (1943) 379, note; *ibid.* 6 (1950) 342.—*Rivea luzonensis* HALLIER f. Bull. Herb. Boiss. 6

(1898) 714, t. 19.—*Rivea glabrata* ELMER, Leaf. Philip. Bot. 1 (1908) 334.

Stems twining, terete, in dry state longitudinally wrinkled, sparsely appressed-pilose, greyish-brown. *Leaves* broadly to narrowly ovate, or oblong, 7–18 by  $3\frac{1}{2}$ –13 cm, truncate or subcordate at the base, attenuate or acuminate at the apex, glabrous above, or with some scattered hairs, sparsely pilose with appressed hairs beneath; nerves 6–7 on either side of midrib; minor nervation reticulate with subparallel secondary veins; petiole  $1\frac{1}{2}$ –4(–8) cm, sparsely appressed-pilose. *Peduncles* axillary, slender, 7–20 cm, sparsely appressed-pilose, or more densely so towards the apex, cymosely branched at the apex, with many (rarely few) flowers in an umbellate cyme. Pedicels 1–2 mm, densely appressed-pubescent. Bracts lanceolate to narrowly oblong, obtuse, 3–7 mm long, appressed-pubescent outside, caducous. *Sepals* equal in length or outer ones a little shorter, ovate-oblong, obtuse, sometimes acutish, *ca* 5–6 mm long, densely greyish or whitish appressed-pilose outside; sepal 3 with one thin glabrous margin; two inner sepals with two thin glabrous margins. *Corolla* funnel-shaped, *ca*  $2\frac{1}{2}$ –3 cm long, reddish; limb distinctly 5-lobed, *ca* 4 cm diam.; lobes ovate, midpetaline bands appressed-sericeous, their tips penicillate, tube and margins of lobes glabrous. Filaments glandular-papillose. Ovary glabrous, 2-celled. *Fruit* globose, *ca* 1 cm or slightly more in diam., purple or pinkish red; sepals slightly enlarged in fruit, inner ones with red margins; fruiting pedicels up to 8 mm, but often shorter; seed 1, globose.

Distr. *Malaysia*: Philippines (Luzon).

Ecol. Common in thickets and forests, especially along mountain streams at low and medium altitudes, ascending to 1500 m (MERRILL).

Use. The stems are used for tying purposes (ELMER).

Vern. *Busilád*, *sabaltukon*, Tag., *deno(k)dokto*, Ig., *tauid-tauid*, Neg., *Philippino wire*, E.

**28. *Argyrea kunstleri* (PRAIN) PRAIN ex OOSTSTR.** Blumea 5 (1943) 382, 383; HOOGL. Blumea 7 (1952) 187, f. 1, h-l.—*Lettsomia kunstleri* PRAIN, J. As. Soc. Beng. 63, 2 (1894) 100.—*Lettsomia curtisii* PRAIN l.c.—*A. curtisii* (PRAIN) PRAIN ex OOSTSTR. l.c. 367.

Stems twining, up to 30 m, young parts fulvous-strigose, sometimes with additional, short, slightly patent hairs. *Leaves* ovate to broadly ovate, 6–15 by 3–10 cm, obtuse to rounded and often shortly attenuate at the base, acuminate at the apex; upper surface glabrous except on the midrib, lower surface densely to sparsely fulvous-hirsute, most densely so on the nerves; midrib and 7–11 nerves on either side prominent beneath, minor nervation reticulate, inconspicuous; petiole 1–5 cm, hairy like the stem. *Peduncles* axillary, terete, longer than petioles, 5–20 cm, hairy like the stem, cymosely 3–30-flowered. Pedicels *ca* 3 mm. Bracts linear-lanceolate, *ca* 5 mm long, slightly hirsute beneath, caducous. *Sepals* unequal, two outer ones broadly ovate with rounded apex, *ca*  $4\frac{1}{2}$  mm

long, hirsute at least in the basal half outside; two inner sepals transverse-elliptic, ca 6 mm long, often incised at the apex, most deeply so in fruit, glabrous outside or sparsely hirsute at the base. *Corolla* funnel-shaped, 15–18 mm long, whitish or pinkish outside, bright red inside; tube broad, limb distinctly 5-lobed, lobes ovate, ca 5 mm long; midpetaline bands hirsute with a glabrous wing on either side along the whole length. Filaments dilated at the base, glabrous. Ovary glabrous, 2-celled. *Fruit* ovoid, ca 15 mm long, deep red, 1-seeded.

Distr. *Malaysia*: Malay Peninsula.

Ecol. Open jungle, up to 700 m.

**29. *Argyreia rubicunda*** CHOISY, Mém. Soc. Phys. Genève 6 (1833) 426; OOSTSTR. *Blumea* 5 (1943) 371, as to the name and synonyms only; *ibid.* 7 (1952) 173; HOGL. *Blumea* 7 (1952) 187.—*Convolvulus rubicundus* WALL. Cat. (1828) no 1409, nom. nud.—*Lettsomia rubicunda* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 195.

Stems twining, densely tomentose as are the petioles and the inflorescences, with light fulvous hairs. *Leaves* elliptic or sometimes ovate-elliptic, 8–16 by 4–10 cm, base rounded, apex shortly acuminate, or obtuse with a short acumen, thinly coriaceous, glabrous above or slightly hairy on the midrib, short-pilose to tomentose beneath, more densely so on the nerves; midrib and 7–9 nerves on either side prominent beneath; petiole short and stout, up to 5 cm. *Peduncles* axillary, slender, terete, 8–15 cm, in fruit up to 20 cm, cymosely branched at the apex, several- to many-flowered; cyme 6–12 cm diam. Bracts small, caducous. Pedicels 2–4 mm long, thick. Two outer *sepals* strongly concave, orbicular or slightly broader than long, rounded at the apex, 6–7 mm long, densely light fulvous tomentose outside, glabrous inside; sepal 3 transverse-elliptic, 6 mm long, outside tomentose with one glabrous margin; two inner sepals transverse-elliptic, 6 mm long, outside densely sericeous with two glabrous margins. *Corolla* funnel-shaped to campanulate, deeply 5-lobed, pink (PRAIN); lobes ovate-oblong (?), with lanceolate, densely hairy midpetaline bands and glabrous margins. *Fruit* ovoid, ca 14 mm long, pinkish white (GRIFFITH) or purplish red (MAIN-GAY), at the base enclosed by the cupular to shortly funnel-shaped calyx, 1-seeded; fruiting calyx ca 8 mm high, ca 12–13 mm diam., tomentose outside.

Distr. *Malaysia*: Malay Peninsula (Negri Sembilan, Malacca).

Vern. *Akar përa bëntak*, *akar saga molek*.

**30. *Argyreia parviflora*** (RIDLEY) OOSTSTR. *Blumea* 5 (1943) 382; *ibid.* 7 (1952) 174.—*Lettsomia parviflora* RIDLEY, Kew Bull. (1925) 86.—*A. glabra* (non CHOISY) OOSTSTR. *Blumea* 5 (1943) 373.

Stems twining, glabrous or nearly so. *Leaves* ovate to elliptic, 6–12 by  $3\frac{1}{2}$ – $8\frac{1}{2}$  cm, thinly coriaceous; base rounded or slightly retuse, apex obtusish or acutish or shortly acuminate, glabrous on both sides or nearly so; midrib prominent

beneath, sulcate above; nerves 5–8 on either side, not or  $\pm$  distinctly prominent beneath, minor nerves parallel, distinctly visible beneath; petiole rather short,  $1\frac{1}{2}$ –4 cm, glabrous or nearly so. *Peduncle* terete, often curved at its base, 3–15 cm, glabrous or shortly appressed-pilose, mainly towards the apex, umbellately cymose, up to 6-flowered. Pedicels as long as or longer than the calyx, 5–9 mm, in fruit 10–18 mm, shortly appressed-pilose. Bracts at base of cyme linear, up to 12 mm long, sparsely pilose, upper ones shorter. *Sepals* slightly unequal, sparsely appressed-pilose with very short hairs; 2 outer ones ovate-triangular, obtuse, ca 5 mm long, 3 inner ones orbicular to transverse-elliptic with rounded to emarginate apex; sepal 3 with one, sepals 4 and 5 with two narrow, glabrous, reddish margins, all 6– $6\frac{1}{2}$  mm long. *Corolla* deeply 5-lobed (only one not fully expanded corolla could be examined), white, tube ca 5–6 mm long, lobes oblong, ca 12–13 mm long, consisting of the midpetaline band with a narrow, thin, glabrous wing on either side along the whole length; midpetaline band glabrous except for the apical portion. Filaments sparsely pilose at the base; ovary glabrous, probably 2-celled. *Fruit* ellipsoid, ca 15 mm long, its base enclosed by the cupular calyx.

Distr. *Malaysia*: Sumatra.

Vern. *Akar dëdaup këtjil*, Palembang.

**31. *Argyreia erinacea*** OOSTSTR. *Blumea* 5 (1943) 374, f. 3, f–g; *ibid.* 7 (1952) 175.

Stems twining, tall; young branches densely set with appressed or subpatent, greyish or fulvous, strigillose hairs, glabrescent. *Leaves* ovate to elliptic, sometimes narrower, 7–13 by ( $2\frac{1}{2}$ – $4\frac{1}{2}$ )–11 cm, subcoriaceous; base rounded to truncate or slightly retuse to subcordate, apex obtuse to shortly acuminate, mucronulate; upper surface glabrous or sparsely strigillose on midrib and basal lateral nerves, lower surface strigillose; midrib and 6–7 nerves on either side prominent beneath; minor nervation indistinct; petiole  $2\frac{1}{2}$ –6 cm, strigillose. *Peduncles* axillary, 3–11 cm, densely strigillose, umbellately cymose at the apex. Pedicels up to 4 mm. Bracts minute, caducous. Two outer *sepals* broadly ovate-triangular, obtuse, ca  $4\frac{1}{2}$  mm long, densely strigillose; sepal 3 orbicular, 5–6 mm long, strigillose, one glabrous margin excepted; two inner sepals orbicular to transverse-elliptic, rounded at the apex, ca 5 mm long, strigillose, the broad lateral margins excepted. *Corolla* deeply 5-lobed, white with pale purple inside; tube ca 6–7 mm long, glabrous; lobes oblong or ovate-oblong, up to 17 mm long; midpetaline bands sericeo-strigillose, margins glabrous. Filaments with thickened glabrous base. Ovary glabrous, 2-celled. *Fruit* ellipsoid, obtuse, up to 12 mm long, red; seed 1. Fruiting pedicels and branches of cyme reflexed.

Distr. *Malaysia*: Borneo (Mt Kinabalu).

Ecol. In forests, 850–1500 m.

**32. *Argyreia micrantha*** OOSTSTR. *Blumea* 5 (1943) 375, f. 3, a–e.—Fig. 60a–b.

Stems twining, up to 12 m high; young branches densely pilose with appressed pale greyish, fulvous or olivaceous, very short and stiff hairs, making the impression of being farinose. *Leaves* ovate-oblong to elliptic-oblong, 7–12 by 2½–6 cm, chartaceous; base rounded, apex acute to acute-acuminate, mucronulate, olive-coloured beneath in dry state, much darker above, sparsely strigillose on both sides, glabrescent; midrib and 7–9 nerves on either side prominent beneath; minor nerva-

glabrous; limb ca 2 cm diam.; lobes oblong, ca 8–10 mm long, reflexed; midpetaline bands sericeo-strigillose, margins glabrous. *Stamens* white; filaments inserted at the mouth of the tube, glabrous at the base. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Borneo (Mt Kinabalu).

Ecol. In the jungle, at ca 1500 m.

Note. The infructescence and fruit described in Blumea 5 (1943) 376 appear to belong to 31. *A. erinacea* OOSTSTR..

**33. *Argyreia discolor* OOSTSTR.** Blumea 7 (1952) 175.

Stems twining; branches terete, densely and more or less appressedly pilose with short, fulvous hairs. *Leaves* ovate, 6–8 by 3–5 cm, subcordate at the base, attenuate towards the obtusish apex, subcoriaceous, upper surface green, glabrous or with some strigillose hairs on the midrib; lower surface purple, sparsely pilose with slightly curved hairs, more densely so on the midrib and the 6–7 nerves on either side; petiole 2–2½ cm, sulcate above, pilose like the branches. *Inflorescences* axillary, densely umbellately cymose at the apex; *peduncle* 4–7 cm, strigose-tomentose as are the branches of it, the pedicels and the minute bracts; pedicels 1–3 mm. *Sepals* strigose-tomentose outside, two outer ones broadly ovate-triangular, obtuse, ca 3½ mm long; sepal 3 orbicular to transverse-elliptic, ca 4 mm long, with one glabrous margin; two inner sepals orbicular to transverse-elliptic, ca 4 mm long, with two glabrous margins. *Corolla* 5-partite, purple, paler tipped; tube ca 6 mm long, glabrous; lobes ovate-oblong, obtuse, up to ca 17 mm long; midpetaline bands sericeous, margins glabrous; filaments inserted at the mouth of the tube, with thickened base. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Br. N. Borneo.

Ecol. At ca 1500 m.

**34. *Argyreia cinerea* OOSTSTR.** Blumea 5 (1943) 374, f. 3, n-s.—*Rivea glabra* HALLIER f. var.; KOORDERS, Minah. (1898) 545.

Stems twining, up to 15–20 m high; young branches densely pale greyish pubescent or shortly tomentose as are the petioles, peduncles and inflorescences; adult branches glabrescent. *Leaves* elliptic-oblong, elliptic or ovate-elliptic, 6–13 by 3½–10 cm; at the base rounded, slightly cordate, or shortly contracted into the petiole; narrowed towards the obtusish, obtuse, or shortly apiculate, mucronulate apex; upper surface strigillose, lower surface with very short, crisped hairs; midrib and 9–12 nerves on either side prominent beneath, flat or slightly sulcate above; minor nervation reticulate; petiole 1½–6 cm. *Peduncles* axillary, much exceeding the petioles, straight or slightly curved, 4½–15 cm, umbellately cymose at the apex, with 3–5 branches. Pedicels 1–2 mm. Lower bracts oblong-lanceolate, 7–15 mm long, upper ones 2–3 mm. Two exterior *sepals* broadly ovate-triangular or semi-orbicular, obtuse to rounded, three interior ones orbicular to transverse-elliptic;



Fig. 60. a-b. *Argyreia micrantha* OOSTSTR. a. Flowering branch,  $\times \frac{1}{2}$ , b. corolla-lobe,  $\times \frac{1}{12}$ , c-d. *Argyreia caudata* OOSTSTR., c. flower,  $\times \frac{1}{12}$ , d. corolla-lobe,  $\times \frac{1}{12}$ .

tion indistinct; petiole 2–3½ cm, pilose like the branches. *Peduncles* axillary, straight, patently erect, terete, 3–12 cm, pilose, umbellately cymose at the apex, with 3–6 branches. Pedicels 2½–5 mm, angular to sulcate, pilose. Bracts caducous. *Sepals* equal, ca 3 mm long, shortly pilose outside; two outer ones broadly ovate-triangular to suborbicular, obtuse; sepal 3 broadly triangular to orbicular, obtuse, with one glabrous margin; two inner sepals transverse-elliptic, broadly rounded at the apex, their lateral margins glabrous. *Corolla* deeply 5-lobed, purple; tube cylindric, ca 4–5 mm long,

all  $2\frac{1}{2}$ –3 mm long, densely pale greyish pubescent to shortly tomentose outside, sepal 3 with one, sepals 4 and 5 with two glabrous lateral margins. *Corolla* small, deeply 5-lobed, white; tube cylindrical,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long; lobes oblong, ca  $5\frac{1}{2}$ –6 mm long, reflexed; midpetaline bands sericeous outside, margins glabrous. Filaments inserted at the mouth of the tube, at the base flattened and with a few very short hairs. Ovary glabrous, 2-celled. *Fruit* ellipsoid, up to 9 mm long, reddish purple.

Distr. *Malaysia*: North Celebes.

Ecol. In forests at 300–400 m.

Vern. *Wuliliten*, Tontemboan.

**35. *Argyreia osyrensis* (ROTH) CHOISY** in DC. Prod. 9 (1845) 334; OOSTSTR. *Blumea* 7 (1952) 177, f. 2, a–c.—*Ipomoea osyrensis* ROTH, Nov. Pl. Spec. (1821) 117.—*Lettsonia aggregata* ROXB. var. *osyrensis* CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 192.

Stems twining, terete, densely white, greyish or pale brown tomentose. *Leaves* ovate or broadly ovate, 4–12 by 4–10 cm; base cordate, apex subacute; lower surface densely tomentose to shortly lanate, upper surface less tomentose (or glabrous); midrib and 7–11 nerves on either side rather prominent beneath; petiole 2–5 cm, tomentose, grooved. *Peduncles*  $2\frac{1}{2}$ –6 cm, densely tomentose; flowers in a capitate inflorescence at the end of the peduncle. Pedicels very short or none. Bracts broadly obovate to spatulate or orbicular, truncate, ca 8–12 mm long, tomentose outside, glabrous inside, subpersistent. Two outer *sepals* obovate to spatulate, obtuse, 9–10 mm long; sepal 3 oblong, obtuse, ca 8 mm long; two inner sepals oblong, obtuse,  $5\frac{1}{2}$ –6 mm long, all tomentose outside and glabrous inside. *Corolla* tubular-campanulate, 12–15 mm long, deeply 5-lobed, pink; tube 6–7 mm long, glabrous; lobes narrowly ovate, emarginate, ca 8 mm long, with a hairy midpetaline band and narrow glabrous margins. *Stamens* and *style* exerted; filaments dilated and hairy at the base. Ovary glabrous, 2-celled. *Fruit* globose, 6–8 mm diam., red, 2–1-seeded, surrounded by the enlarged concave sepals, which are red within; seeds subglobose.

Distr. Deccan Peninsula, Ceylon, Burma, Indo-China, Siam, Tenasserim, in *Malaysia*: N. Sumatra (Atjeh).

Ecol. In dry open places.

Note. The name *Argyreia aggregata* (ROXB.) CHOISY, Mém. Soc. Phys. Genève 6 (1833) 427, under which name this species has been mentioned by VAN OOSTSTROOM in *Blumea* 5 (1943) 380, refers to specimens with a glabrous upper leaf-surface. Such specimens appear to be confined to the Deccan Peninsula. They are, most probably, not specifically distinct.

**36. *Argyreia pseudorubicunda*** OOSTSTR. *Blumea* 7 (1952) 173.—*A. rubicunda* (non CHOISY) OOSTSTR. *Blumea* 5 (1943) 371.

Stems twining, up to 5 m high, more or less densely and shortly appressed-pilose, later on

glabrous. *Leaves* ovate-oblong, ovate or elliptic,  $6\frac{1}{2}$ –16 by  $3\frac{1}{2}$ –10 cm, base rounded or slightly cordate, apex obtuse to acute; subcoriaceous, glabrous above, or with some hairs on midrib, more or less densely appressed-pilose beneath; midrib and 6–10 nerves on either side prominent beneath; petiole 2–10 cm, pilose like the stems. *Peduncles* 5–20 cm, pilose like the stems, cymosely ramified at the apex, many-flowered. Pedicels 1–4 mm, in fruit up to 10 mm. Bracts minute, 1–2 mm long, caducous, rarely a casual foliaceous bract in the cyme. Two outer *sepals* ovate-triangular, obtuse, 5 mm long, appressed-pilose outside or partly glabrescent, glabrous inside; sepal 3 orbicular or somewhat transverse-elliptic, 5–6 mm long, appressed-pilose with one glabrous margin, two inner sepals transverse-elliptic, strongly concave, 5– $6\frac{1}{2}$  mm long, appressed-pilose with 2 glabrous margins. *Corolla* deeply 5-lobed, pinkish purple; tube cylindrical, ca 6 mm long, glabrous, lobes linear or linear-lanceolate, reflexed, ca 16–18 mm long, appressed-sericeous outside, at the apex with 2 small glabrous lobules. Filaments with a large tooth at the glabrous base. Ovary glabrous, 2-celled. *Fruit* ellipsoid, ca 15 mm long, pink.

Distr. *Malaysia*: Sumatra.

Ecol. Thickets, secondary and primary forests, 360–800 m.

Note. The density of the indumentum of stems, lower surface of leaves and inflorescences appears to be variable; it varies from densely pilose or nearly tomentose to nearly glabrous.

**37. *Argyreia caudata*** OOSTSTR. *Blumea* 5 (1943) 379, f. 3, h–m.—Fig. 60c–d.

Stems twining, up to 10 m high; branches terete, shortly greyish tomentose, solid. *Leaves* narrowly ovate to ovate-lanceolate, or ovate to elliptic, 7–16 by 2–12 cm; base rounded, or slightly cordate, apex acuminate, often with a linear acumen, or shortly cuspidate; lower surface more or less densely pilose with short, soft hairs, upper surface less densely pilose with more stiff hairs; midrib and 9–10 nerves on either side prominent beneath; minor nervation more or less distinct; petiole 2–8 cm long, shortly tomentose. *Inflorescences* approximate at the end of the branches in an elongate, narrow panicle; peduncles 1–8 cm, tomentose. Pedicels 4–5 mm, angular, thickened in fruit. Bracts lanceolate or narrowly lanceolate, apex caudate. Two outer *sepals* broadly ovate to elliptic, shortly to long and narrowly acuminate, 8–10 mm long; sepal 3 ovate, shortly acuminate, ca  $7\frac{1}{2}$ –9 mm long; two inner sepals ovate to elliptic, obtuse, but shortly cuspidate, ca 6–7 mm long, all pilose outside, glabrous inside. *Corolla* deeply 5-lobed, rose-purple; tube ca 8 mm long, glabrous; lobes linear, ca 18–20 mm long, appressed-sericeous to strigillose outside, winged towards the apex with glabrous wings. Filaments thickened and verrucose at the base. Ovary glabrous, 2-celled. *Fruit* ellipsoid or subglobose, ca 10–12 mm long, purple-red.

Distr. *Malaysia*: Borneo.

Ecol. In the jungle, 800–1500 m.

**38. *Argyreia boholensis* (MERR.) OOSTSTR.** *Blumea* 6 (1950) 345.—*Lettsonia boholensis* MERR. Philip. J. Sc. 29 (1926) 485.

Stems twining, terete or upwards slightly angular, glabrous, pale greyish-brown. *Leaves* ovate or ovate-oblong, 4–10 by  $1\frac{1}{2}$ –7 cm, rounded or very slightly cordate at the base, acute to shortly acuminate at the apex, thinly coriaceous, in dry state greyish or olivaceous, glabrous, or with a few hairs on the nerves, mainly on the midrib beneath; nerves 8–10 on either side of the midrib; petiole 2–3½ cm, glabrous. *Peduncles* in the upper leaf-axils, cymosely 1–3(–5)-flowered, 2–7½ cm, glabrous or with some hairs. Pedicels of central flower ca 8–10 mm, of lateral flowers often shorter, glabrous. Bracts narrowly triangular, with incurved apex, ca 2 mm long, glabrous. *Sepals* glabrous, coriaceous; 2 outer ones broadly ovate-triangular, obtuse, 5 mm long, sepal 3 broadly ovate, obtuse, 5 mm long, with one broad thin margin; two inner sepals broader than long, broadly rounded, concave, ca 4 mm long, with two broad thinner margins. *Corolla* with deeply divided limb; lobes linear, reflexed and twisted, ca 18 mm long, densely sericeous outside, at the apex with 2 triangular glabrous lobules; tube cylindric, ca 8 mm long, glabrous. Filaments geniculate near their thick, broadened base, pubescent. Ovary glabrous, 2-celled. 'Young fruits oblong-ellipsoid, glabrous, ca 1 cm long' (MERRILL).

Distr. *Malaysia*: Philippines (Bohol).

Ecol. In openings in the forest and along streams, 300–600 m.

Note. A fruiting specimen collected in Luzon, Prov. of Tayabas, Kinataktan, by ORO, For. Bur. 30672, Herb. N.Y., much resembles this species, but has the sepals appressed-pilose outside; fruit ellipsoid, 12–14 mm long, pink.

**39. *Argyreia barnesii* (MERR.) OOSTSTR.** *Blumea* 6 (1950) 343.—*Rivea barnesii* MERR. Bur. Govt Lab. Publ. 17 (1904) 40.—*Rivea cinerea* ELM. Leaf. Philip. Bot. 1 (1908) 335.

#### KEY TO THE VARIETIES

1. Bracts lanceolate, acuminate. Sepals 7–8 mm long . . . . . *var. barnesii*
1. Bracts linear, with a long and linear to filiform acumen. Sepals ca 5 mm long.

#### *var. urdanetensis*

#### *var. barnesii*.

Stems twining, terete, young parts densely pubescent to tomentose, adult parts glabrescent. *Leaves* ovate-oblong, ovate or broadly ovate, 6–18 by  $3\frac{1}{2}$ –13 cm, rounded or cordate at the base, shortly to long-acuminate or caudate and mucronulate at the apex, more or less densely and softly pilose to tomentose on both sides, sometimes nearly glabrous above; nerves 7–9(–12) on either side of the midrib; petiole 2–5 cm, densely pubescent. *Peduncles* axillary, 2–14 cm long, one- to many-flowered, pubescent like the stem. Pedicels much shorter than or nearly as long as the sepals, elongated in fruit. Bracts lanceolate, acuminate, lower ones ca 1–2 cm long, pubescent

on both sides. *Sepals* nearly equal in length, 7–8 mm long; two outer ones ovate to broadly elliptic, obtuse or mucronulate, pubescent to tomentose outside; sepal 3 broadly elliptic to orbicular, obtuse or truncate, with one glabrous margin; two inner sepals orbicular, emarginate, with two glabrous margins. *Corolla* 5-parted, lavender; lobes linear, ca 20 by 3–4 mm, densely sericeous outside towards the base, at the apex with 2 triangular glabrous lobules; tube ca 9 mm long, glabrous. Filaments with a tooth above the base, glabrous. Ovary glabrous, 2-celled. *Fruit* ellipsoid, up to  $1\frac{1}{2}$ (–2) cm long, purple, at the base enclosed by the slightly enlarged sepals; seed 1, ellipsoid, 1 cm long.

Distr. *Malaysia*: Philippines (Luzon, Mindoro, Guimaras Isl., Samar, Leyte, Mindanao).

Ecol. In forests at low and medium altitudes forming tangled masses over the tops of trees and larger shrubs.

Use. The stems are used for tying purposes.

Vern. *Quahal, guahal*, Ig.

Note. The density of the indumentum is extremely variable in this species; the leaves are densely tomentose on both surfaces or much less pilose to glabrous above and sparsely pilose beneath; the same is found in the density of the indumentum on stems and inflorescences.

*var. urdanetensis* (ELMER) OOSTSTR. *Blumea* 6 (1950) 344.—*Rivea urdanetensis* ELM. Leaf. Philip. Bot. 7 (1915) 2605.

*Sepals* smaller, 5 mm long. *Corolla*-lobes glabrous in their basal portion instead of pilose to the base. Bracts narrower, linear, with a long and linear to filiform acumen.

Distr. *Malaysia*: Philippines (Mindanao).

Ecol. In forests, 600 m.

Vern. *Cawilan, kaulilan*, Man..

**40. *Argyreia apoensis* (ELMER) OOSTSTR.** *Blumea* 6 (1950) 344.—*Rivea apoensis* ELM. Leaf. Philip. Bot. 7 (1915) 2604.

Stems twining, sparsely appressed-pilose, glabrescent. *Leaves* ovate, 6–10 by  $3\frac{1}{2}$ –6 cm, base truncate or slightly cordate, apex acute to acuminate, upper surface glabrous, lower appressed-pilose, especially along the nerves; nerves 6–8 on either side of midrib; petiole 2–3 cm, appressed-pilose. *Peduncles* in the upper leaf-axils, up to 9 cm long, appressed-pilose towards their apex with yellowish-grey hairs; cymes umbellate, few-flowered. Pedicels 2–4 mm, rather densely appressed-pilose. Bracts 8–12 mm long, linear to filiform, with a narrow acumen, hairy beneath, glabrous above. *Sepals* nearly equal in length, ca  $6\frac{1}{2}$  mm long, densely appressed-pilose outside; 2 outer ones elliptic-oblong, obtuse, mucronulate; sepal 3 broader, with one glabrous margin; two inner sepals broadly ovate to orbicular, with two glabrous margins. *Corolla* 5-parted, whitish outside, purplish or violaceous inside; tube ca 11 mm long, glabrous; lobes linear, recurved and twisted, ca 24 by 3 mm; midpetaline bands sericeous outside towards the apex, and there with two gla-

brous wings. Filaments with slightly dilated, thick, papillose base. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Philippines (Mindanao).

Ecol. In forests, ca 450 m, forming dense tangled masses.

Vern. *Dalumosip*, Bag..

Note. Closely related to 39. *A. barnesii* and possibly only a variety of that species.

**41. *Argyreia congesta* OOSTSTR.** *Blumea* 7 (1952) 176, f. 2, d-f.

Stems twining, densely appressed-pilose to tomentose, with fulvous hairs. *Leaves* narrowly ovate or ovate, 8-17 by  $3\frac{1}{2}$ -9 cm, rounded at the base, attenuate towards the acute or acuminate apex; lower surface densely appressed-pilose with straight or slightly curved hairs, or almost tomentose in youth, upper surface less densely hairy with more rigid hairs; midrib and 8-10 nerves on either side distinctly visible on both sides; petiole 3-8 cm, grooved, pilose like the stem. *Peduncles* axillary, terete, rather slender, 4-10 cm, densely pilose; flowers in a small, dense, more or less capitate cyme; branches of cyme very short. Pedicels 2-4 mm. Bracts subsistent, broadly obovate, rounded to truncate at the apex, ca 10-12 mm long, densely appressed-pilose outside, glabrous inside. *Sepals* concave, elliptic-oblong, obtuse; two outer ones ca 8 mm long, outside pilose like the bracts, inside glabrous; sepal 3 slightly oblique, ca 7 mm long, outside pilose with one glabrous margin; two inner sepals ca  $6\frac{1}{2}$  mm long, nearly glabrous. *Corolla* deeply 5-fid, pink, the lobes with white tips; tube ca 5 mm long, glabrous; lobes linear, ca 17 mm long, densely hairy outside, with 2 glabrous lobules at the apex. Filaments inserted at the mouth of the tube, glabrous. Ovary glabrous, 2-celled. *Fruit* unknown.

Distr. *Malaysia*: Br. N. Borneo.

**42. *Argyreia celebica* OOSTSTR.** *Blumea* 5 (1943) 377, f. 2, f-g.—**Fig. 61 b.**

Stems twining, 15-25 m high; branches terete, greyish brown, glabrous. *Leaves* oblong-lanceolate to narrowly ovate-oblong, 7-14 by 3-5½ cm; rounded or shortly attenuate at the base; gradually attenuate towards the acutish apex, glabrous on both sides; midrib prominent beneath, nerves 6-7 on either side prominent beneath, curved; minor nervation indistinct; petiole  $1\frac{1}{2}$ -4½ cm, glabrous. *Peduncles* straight or slightly curved,  $2\frac{1}{2}$ -9 cm, glabrous, with 2-4, sometimes with more fruits at the apex. Fruiting pedicels up to 10 mm long, slightly angular or sulcate, thickened and often curved towards the apex. *Sepals* below the fruit broadly ovate-triangular or semi-orbicular, equal, ca 3-4 mm long, appressed-pilose outside, the reddish margins of sepals 3 and 4 excepted. *Fruits* often nodding, ellipsoid, up to  $1\frac{1}{4}$  cm long (mature?), red; seed 1, ellipsoid.

Distr. *Malaysia*: N. Celebes.

Ecol. In primary forests and in clearings, 500-1000 m.

Vern. *Kunit*, *pahanap*, Manado.

**43. *Argyreia crispa* OOSTSTR.** *Blumea* 7 (1952) 172, f. 1.—**Fig. 61 a.**

Stems twining, densely pilose with short, subpatent hairs as are the petioles and the inflorescences. Branches terete or subangular towards the apex. *Leaves* ovate to ovate-oblong, 8-13 by 4-8 cm, subcordate at the base, acute or obtusish at the apex, glabrous above, pilose beneath, mainly on the nerves; midrib flat above or slightly impressed, prominent beneath, 5-7 nerves on either side prominent beneath, minor nervation indistinct; petiole 2-6 cm, terete at the base, more or less flattened towards the apex. *Fruiting peduncles* 8-22 cm long, terete, corymbosely branched at the apex. Pedicels 3-5 mm. Bracts caducous. *Fruiting sepals* unequal; three outer ones ovate, obtuse, ca 10 mm long, pilose outside, glabrous inside, with strongly crisped margins; two inner sepals ovate-oblong, obtuse, ca 8-9 mm long, flat or slightly concave, outside pilose in the middle portion, and with broad glabrous margins. *Fruit* ellipsoid, 12-14 mm long, purplish-red; seed 1, ellipsoid.

Distr. *Malaysia*: N. Sumatra.

Ecol. Edges of, and in, first growth jungle, 1000-1200 m.

Note. See under 46. *A. robinsonii* (RIDLEY) OOSTSTR.

**44. *Argyreia paucinervia* OOSTSTR.** *Blumea* 6 (1950) 347, f. 1, a.—**Fig. 62.**

Stems twining, young parts appressed-pilose, soon glabrous, pale fulvous or greyish. *Leaves* oblong or narrowly oblong to lanceolate, 10-16 by 2-4 cm, acutely attenuate to cuneate at the base, gradually attenuate towards the obtusish apex, in youth very sparsely pilose beneath with short, appressed hairs, afterwards glabrous; glabrous above; midrib and 3-4 nerves on either side rather flat above and beneath; nerves ascending at sharp angles; petiole  $1\frac{1}{2}$ -2½ cm, with some short, appressed hairs, or glabrous. *Fruiting peduncles* in the upper leaf-axils, 2-3 cm long, with some appressed hairs, glabrescent, cymosely branched at the apex, with divaricate branches and 3-5 fruits. Bracts linear or narrowly spatulate, obtuse, 20-25 mm long (these bracts not inserted at the base of the branches of the cyme, but at the base of the pedicels). Fruiting pedicels 2-4 mm long. *Sepals* equal in length, ca 6-7 mm long; three outer ones ovate, obtusish at the apex; two inner ones broadly ovate, obtuse to emarginate or irregularly dentate at the apex, all sparsely appressed-hairy in the middle portion, or glabrous. *Fruit* globose, ca 1 cm diam., red; seed 1, globose.

Distr. *Malaysia*: Philippines (Luzon).

Ecol. Forest slopes, ca 1000 m.

**45. *Argyreia samarensis* OOSTSTR.** *Blumea* 6 (1950) 347, f. 1, b.—**Fig. 61 c.**

Stems twining; young parts hirsute, glabrescent, pale fulvous. *Leaves* broadly to narrowly ovate, (5-9)-14 by ( $2\frac{1}{2}$ )-4-9 cm, base broadly rounded to subcordate, apex acute or slightly acuminate; sparsely hirsute on both sides; midrib and 8-11



Fig. 61. a. *Argyreia crispa* OOSTSTR., fruiting branch,  $\times \frac{1}{2}$ , and fruit,  $\times 2\frac{1}{2}$ , b. *A. celebica* OOSTSTR., fruiting branch,  $\times \frac{1}{2}$ , c. *A. samarensis* OOSTSTR., fruiting branch,  $\times \frac{1}{2}$ .



nerves on either side slightly prominent beneath; petiole much shorter than blade, 2–5 cm, hirsute. *Fruiting peduncles* axillary, 4–10 cm long, hirsute, cymosely branched at the apex, bearing 3–8 fruits. Bracts caducous. Fruiting pedicels 5–10 mm long,



Fig. 62. *Argyreia paucinervia* OOSTSTR. Fruiting branch,  $\times 1/3$ .

hirsute, thickened above. Two outer *sepals* elliptic, obtuse, 9 mm long, hirsute outside; sepal 3 orbicular with rounded apex, 8 mm long, hirsute, with one glabrous margin; two inner sepals orbicular, rounded to slightly emarginate, 8 mm long, hirsute, with two glabrous margins. *Fruit* ellipsoid or ovoid, ca 18 mm long; seed 1, ellipsoid, ca 15 mm long.

Distr. *Malaysia*: Philippines (Samar).

**46. *Argyreia robinsonii* (RIDLEY) OOSTSTR.** *Blumea* 5 (1943) 381.—*Lettsomia robinsonii* RIDLEY, J. Fed. Mal. Stat. Mus. 8, 4 (1917) 65.

A twiner with appressed-hairy stems. *Leaves* lanceolate to ovate, 6–12 by  $2\frac{1}{2}$ – $7\frac{1}{2}$  cm, rounded or obtuse at the base, subacute at the apex, thinly coriaceous, glabrous above, appressed-hairy beneath; lateral nerves 8 on either side of the midrib, prominent beneath; petiole 1–8 cm, hairy. *Peduncles* 4–18 cm long, hairy. Cymes lax, many-flowered, 1–4 cm long. Pedicels 5 mm long. Bracts minute, ovate, acute. *Sepals* oblong, truncate, 4 mm long, glabrous. *Corolla* with a short, glabrous, campanulate, 8 mm long tube; the lobes sericeous outside, glabrous inside, white to purple, reflexed and oblong. Stamens long exserted, filaments filiform, anthers oblong; style slightly shorter than the stamens, stigma capitate (RIDLEY).

Distr. *Malaysia*: Sumatra (W. Coast).

Ecol. At 900 m.

Note. The type of this species is unknown to me. The specimens BANGHAM 840 and 1134 from N. Sumatra, mentioned by MERRILL (Contr. Arn. Arb. 8, 1934, 145) as conspecific, belong to 43. *A. crispa* OOSTSTR.

#### Doubtful

*Argyreia malabarica* CHOISY, *A. nellygherya* CHOISY, and *A. populifolia* CHOISY, mentioned by FERNANDEZ-VILLAR, Novissima Appendix (1880) 139, do not occur in the Philippine Islands.

*Argyreia roxburghii* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 419; OOSTSTR. *Blumea* 5 (1943) 383.

MIQUEL, Fl. Ind. Bat. 2 (1857) 586 mentions a specimen collected in the Moluccas by REINWARDT. This specimen is unknown to me; it is very doubtful that the species occurs in the Moluccas.

*Argyreia setosa* CHOISY, Mém. Soc. Phys. Genève 6 (1833) 425; OOSTSTR. *Blumea* 5 (1943) 383.

It is very doubtful that this species occurs in the island of Timor.

*Rivea hypocateriformis* CHOISY and *Rivea ornata* CHOISY, both mentioned for Malaysia by BOERLAGE, Handl. Fl. Ned. Ind. 2 (1899) 513, do not occur there.

#### Excluded

*Rivea leucocarpa* ELMER, Leaf. Philip. Bot. 10 (1939) 3720, belongs to the genus *Ehretia* (Boraginaceae).

## SONNERATIACEAE (concluded)

### SONNERATIACEAE AND OTHER MANGROVE-SWAMP FAMILIES, ANATOMICAL STRUCTURE AND WATER RELATIONS

(C. A. Reinders-Gouwentak, Wageningen)

The question whether tidal and non-tidal members of a family have a separate wood anatomical structure would be examined best in such genera as embrace both types. The sequel to this examination, whether any such differences are connected with peculiarities in the water relations of the plants, should be examined in the same way. There are, however, few genera that comprise both littoral and inland species. In some of these genera, *Excoecaria*, *Ixora* and *Dolichandrone*, wood anatomical data can be compared but water relations among the species have not been examined nor are comparative data from the nearest relatives available.

According to MOLL & JANSSONIUS the mangrove-swamp species possess more vessels per mm<sup>2</sup> with a larger total area on cross section and the pores are mostly distinctly smaller than in the nearest related inland species. However, data on area JANSSONIUS did not record.

*Excoecaria agallocha* L. has 7–14 vessels per mm<sup>2</sup> of cross section with a diameter up to 80  $\mu$ , whereas these data in *E. virgata* Zoll. & Mor. are 3–6 per mm<sup>2</sup> and 40–150  $\mu$ . The total area occupied in the tidal species by the water conductive tissue is said to be larger than in the non-tidal *E. virgata*. The same relations are found among *Ixora paludosa* Boerl. [KOORDERS & VALETON 8 (1902) 156] and the other Javanese *Ixora* species (MOLL & JANSSONIUS, JANSSONIUS, PANSIN, PEARSON & BROWN). As regards *Dolichandrone spathacea* (L. f.) K. Schum. and inland species from India, the tidal species *D. spathacea* has 4–6 vessels per mm<sup>2</sup> with a diameter of 40–150  $\mu$  (MOLL & JANSSONIUS, JANSSONIUS) or 9–12 per mm<sup>2</sup> and 120–130  $\mu$  (PANSIN). In the inland species [*D. atrovirens* Sprague (= *D. crispa* Seem.), *D. falcata* Seem., *D. arcuata* C. B. Clarke] the vessel number is scanty to rather scanty and the diameter has been classified as small (GAMBLE) which data do not differ appreciably from those found in the tidal species.

With regard to the tidal and non-tidal genera in the same families, JANSSONIUS found the said tendency. The data e.g. for the tidal genus *Sonneratia* and the inland genus *Duabanga* are 35–40 against 4–5 per mm<sup>2</sup> and the diameter is 35–175  $\mu$  against 130–400  $\mu$  respectively. JANSSONIUS also found these relations among genera of the *Combretaceae* (cf. PANSIN) and the *Meliaceae* but less conspicuously in the latter family. Vessels are extremely numerous in *Aegiceras* with 200 per mm<sup>2</sup> and less so in the other *Myrsinaceae* where 100 or less and 140 at the utmost have been found. An exception is formed by *Heritiera littoralis* Dry. which species with 5,1 vessels/mm<sup>2</sup> and a pore diameter of 100–175  $\mu$  (CHATTAWAY, DEN BERGER) does not differ markedly from the other genera of the *Sterculiaceae*.

As regards the *Rhizophoraceae* JANSSONIUS's data seem to point to vessels being more numerous and smaller in the tidal tribe but the data have not been quite confirmed by MARCO.

The tidal species in which the vessel number per cross section is less than 15 per mm<sup>2</sup> with the exception of *Heritiera* are characterized by thinner-walled libriform fibers with wider lumina (PANSIN).

The same differences have been recorded between two tidal species of *Sonneratia* of which *Sonneratia apetala* Ham. in the Delta forests of Bengal at a river mouth grows in less salty localities than *Sonneratia griffithii* Kurz. *Sonneratia apetala* has 18–32 vessels per mm<sup>2</sup> with a diameter of 135–150  $\mu$  against the data 34–50 and 85–100  $\mu$  in *Sonneratia griffithii* Kurz (PEARSON & BROWN). JANSSONIUS, however, did not find these facts in *Sonneratia alba* J. E. Smith from the outer fringe and *Sonneratia caseolaris* (L.) Engl. from the inner zone of the mangrove swamp formation (Fl. Mal. I, 4, p. 280; TROLL & DRAGENDORFF) in Java, both species showing the same vessel number.

However, in the non-tidal genus *Markhamia* (*M. platycalyx* (Bak.) Sprague; *M. stipulata* Seem. = *Dolichandrone stipulata* Benth. in PEARSON & BROWN) even more vessels have been reported than in the tidal genus *Dolichandrone* (PEARSON & BROWN, HARRIS & EGGELING).

Discrepancy among data such as in the *Bignoniaceae* and in the *Rhizophoraceae* can be attributed to variations due to the place of taking samples in the tree. This statement is supported by the following example. In *Bruguiera gymnorhiza* Lamk. PEARSON & BROWN report 40–62 vessels per mm<sup>2</sup> with a maximum tg diameter of 115–135  $\mu$  whereas JANSSONIUS found 25 vessels and a maximum diameter of 115  $\mu$ . These facts may mean that the latter author did not examine mature wood. Consequently, future investigators would do well to eliminate the influence of different age and of different height in the tree.

Summarizing the data it may be concluded that there is in the tidal species a tendency towards increase of the number of vessels and the total area of water conductive tissue in the cross section and a tendency towards decrease of the vessel diameter. Not justified seems to be JANSSONIUS's suggestion that the variation in number of vessels per unit area in 3 species of *Bruguiera* might be correlated with the different number of every month inundations (DE HAAN). Cf. PANSHIN for data on *Bruguieras*.

The anatomy of leaf and stem shows structural features that are called xeromorphic by MULLAN and non-xeromorphic by SHMUELI. WALTER & STEINER avoid using the terms.

*Succulent leaves* are a common feature and induced by the presence of a distinct hypodermal aqueous tissue which in *Sonneratia* even forms an inner layer of many cells [WALTER & STEINER, MULLAN (a, c, d)]. In leaves that are immersed during high tide the layer is 3–5 times as thick as at a higher level in the tree and it is almost absent in plants grown in fresh water in botanical gardens. Succulence appears to be a response to the presence of chloride in the medium (WALTER & STEINER, VAN EYK, see also review by UPHOF).

Under mesophytic conditions the salt excreting *glandular hairs* developed feebly [MULLAN (b)] and salt incrustations failed to appear on the leaves of the plant studied (*Acanthus ilicifolius* L.).

As regards water relations: *transpiration*, *osmotic pressure* and *suction force* have been studied.

*Transpiration* in mangroves and in halophytes in general appears to be low (WALTER & STEINER, WALTER (b), ADRIANI, SHMUELI) as it was once supposed to be by SCHIMPER, and by no means considerable (see WALTER & STEINER, footnote p. 106) as VON FABER's data seemed to suggest (VON FABER, UPHOF). Transpiration in *Sonneratia* and other typical mangrove trees if expressed in mg/g fresh weight or in mg/unit leaf area (WALTER & STEINER) is equal to or even lower than the water loss in glycophytic tropical trees (STOCKER) or in the mesophytes studied by PISEK & CARTELLIERI (a). Comparative data from the nearest relatives are not available. In recent ecological work in other plant associations transpiration per m<sup>2</sup> of soil area is studied [PISEK & CARTELLIERI (b)].

Although not being as high as it was originally thought, the *osmotic value* in the cells of the leaves is always higher than in the soil or in the sea water. WALTER & STEINER with the kryoskopik method found that *Sonneratia alba* J. E. Smith has an osmotic value of about 32 atms whereas in the soil and in the sea water this value fluctuates between 20 and 25 atms. Similar data have been recorded for other tidal genera. BLUM using the plasmolytic method found *ca* 50 atms in the same (? : "*albida*") species. SEN GUPTA (a) with the kryoskopik method found the osmotic values in *Rhizophora* and other mangrove trees in India to be somewhere between those of WALTER & STEINER and of BLUM. No data are available about the osmotic pressure of related non-tidal species or genera but it is a well known fact that the glycophytes (except some xerophytes) do not show such high values. Such tidal species as are not obligate halophytic (cf. BENECKE & ARNOLD) show lower osmotic values if they are grown artificially in glycophytic conditions (Bogor Botanical Gardens). BLUM in the upper epidermis of the leaf of *Sonneratia caseolaris* (L.) Engl. (*S. acida*) calculated the pressure to be 22 atms whereas in the natural habitat this value was 27 atms. The same conditions prevail in connection with the salinity of the natural habitat, the higher value being found in the seaward zone. WALTER & STEINER found the osmotic pressure in *Avicennia marina* (Forsk.) Vierh. var. *typica* Bakh. ranging from 35–46 atms. SEN GUPTA (a) is confirming this statement for all species studied by him with the only exception of *Excoecaria agallocha*. In this species the higher value of 43 atms has been found in the brackish

water with the lower osmotic value, whereas in a more salty habitat 26 atms were calculated. No explanation has been presented for this apparently exceptional case.

SEN GUPTA (b) studied the annual variation of osmotic values and found low values at the time of flowering and fruiting.

It seems now well agreed that VON FABER's data of 60–160 atms are overrated and due to methodic errors.

COOPER & PASHA and BLUM are bringing data on the *suction pressure* values of mangrove swamp plants [see also WALTER (a)]. In the lower littoral zone where the sea water always covers the ground suction pressure did not vary with the tides and in *Rhizophora conjugata* was found to be 33 atms. In plants growing in brackish water in the vicinity of river mouths e.g. in *Sonneratia caseolaris* (*S. acida*), there is a difference of about 5 atms, the higher value (27 atms) being found during high tide against 23 atms at low tide. Contrarily, in plants from more saline localities, as in *Sonneratia alba* (*S. albida*), the higher value of 40 atms has been found during low tide and the lower one of 34 atms at high tide. The difference between suction pressure at a level of 8 m in the tree and substratum was found by BLUM to be ca 20 atms. BLUM for purposes of comparison studied suction pressure in trees of the rain-forest and found values of 15,1 atms and 0,3 atms in leaf and soil. Only one tree species has been mentioned by name: *Excoecaria agallocha* which species is not an inland species but a mangrove plant and as such is not the right example to illustrate differences in suction pressure in the rain-forest soil.

COOPER & PASHA found high osmotic values and suction force values with little difference between the two figures. An increase was found from July to October [60–80 atms].

Summarizing physiological and anatomical data we may conclude that succulency, formation of glandular hairs, osmotic pressure and suction force values are to a certain extent depending on environmental conditions. Further research about the water balance especially about the saturation deficit of mangrove tree species and related inland species will have to be awaited (cf. ROUSCHAL; CRAFTS *et al.*). The smaller diameter of the pores in the mangrove tree might be advantageous as in such narrow vessels the rupture of the water column may be hampered. Whether the larger area of water conductive tissue in the tidal species would be advantageous also, depends on physical properties that cannot be discussed here. The anatomical data, however, will have to be verified in connection with the variations resulting from wood samples taken in different annual rings and at different heights in the tree.

*References:*—ADRIANI (a), Proc. Kon. Ned. Ak. Wet. Amsterdam 40 (1937) 524; (b), Comm. 88, Sigma, Montpellier (1945); BACKER & VAN STEENIS, Fl. Mal. I, 4 (1951) 280; BECKING *et al.*, Tectona 15 (1922) 561; DEN BERGER, Handel. N. I. Natuurwet. Congr. 4 (1927) 397; BENECKE & ARNOLD, Planta 14 (1931) 471; BLUM, Ber. Schweiz. Bot. Ges. 51 (1941) 401; CHATTAWAY, Phil. Trans. Roy. Soc. London 228 (1937) 313; COOPER & PASHA, J. Indian Bot. Soc. 14 (1935) 109; CRAFTS *et al.*, Water in the Physiology of Plants (1949); VAN EYK, Rec. Trav. Bot. Néerl. 36 (1939) 559; VON FABER in SCHIMPER-VON FABER, Pflanzengeographie 1 (1935) 35; GAMBLE, Man. Indian Timb. (1922) 511; DE HAAN, Tectona 24 (1931) 39; HARRIS & EGGELING in CHALK *et al.*, For. Trees & Timb. Brit. Emp. 4 (1939) 21; JANSSONIUS, Blumea 6 (1950) 465; KOORDERS & VALETON 8 (1902) 156; MARCO, Trop. Woods 44 (1935) 1; MOLL & JANS-SONIUS, Mikr. Holzes 1–6 (1906–1936); MULLAN (a), J. Indian Bot. Soc. 10 (1931) 126; (b), *ibid.* 10 (1931) 184; (c), *ibid.* 11 (1932) 103 and 285; (d), *ibid.* 12 (1933) 165 and 235; PANSHIN, Philip. J. Sc. 48 (1932) 143; PEARSON & BROWN, Commercial Timb. India 1 & 2 (1932); PISEK & CARTELLIERI (a), Jahrb. Wiss. Bot. 79 (1934) 131; (b), *ibid.* 90 (1941) 255; ROUSCHAL, Jahrb. Wiss. Bot. 87 (1939) 436; SEN GUPTA (a), Ber. D. B. G. 56 (1938) 474; (b), J. Indian Bot. Soc. 26 (1947) 157; SHMUELI, Palest. J. Bot. Jerus. ser. 4 (1948) 117; STOCKER, Jahrb. Wiss. Bot. 81 (1935) 464; TROLL & DRAGENDORFF, Planta 13 (1931) 311; UPHOF, Bot. Review 7 (1941) 1; WALTER (a), Zeitschr. Bot. 23 (1930) 74; (b), Ber. Schweiz. Bot. Ges. 46 (1936) 217; WALTER & STEINER, Zeitschr. Bot. 30 (1936) 65.



## PENTAPHRAGMATACEAE (H. K. AIRY SHAW, Kew)

AIRY SHAW, Kew Bull. 1941, 233 (1942); LEMÉE, Dict. Descr. Suppl. 9 (1951) 201. —*Campanulaceae*—*Campanuloideae*—*Pentaphragmeae* SCHÖNL. in E. & P. Nat. Pfl. Fam. 4, 5 (1889) 40, 68. —*Saxifragaceae* 'sect. *Francfleuriae*' CHEV. & GAGNEP. Rev. Bot. Appl. 7 (1927) 663. —'*Pentaphragmacées*' GAGNEP. *op. cit.* 8 (1928) 622, in *adnot., nom. provis.*

Perennial  $\pm$  succulent herbs, often somewhat woody and procumbent and rooting at the base, often clothed with branched multicellular hairs; habit sometimes recalling certain *Gesneriaceae* (*Cyrtandra*, etc.). *Leaves* alternate, simple, mostly  $\pm$  asymmetrical, sinuate-denticulate or subentire,  $\pm$  fleshy, petiolate, exstipulate. *Inflorescences* axillary, cymose, often scorpioid, acropetal, solitary or 2–3 together in each axil. *Bracts* usually rather large and membranous. *Flowers* hermaphrodite (rarely unisexual), actinomorphic (calyx excepted), shortly pedicelled or sessile. *Calyx*-tube campanulate or linear-cylindric, adnate to the ovary by means of 5 longitudinal septa formed by the continuation of the filaments, leaving 5 deep nectariferous pits below the petals; lobes 5, imbricate, mostly membranous, persistent, unequal (2 larger and 3 smaller), coloured (mostly whitish). *Corolla* inserted at the apex of the calyx-tube, variously gamopetalous or less frequently choripetalous,  $\pm$  campanulate, mostly fleshy or cartilaginous, occasionally delicate in texture, persistent, segments or petals 5 (rarely 4), valvate (sometimes induplicate), often reflexed at the apex. *Stamens* 5, alternipetalous, shortly adnate to the corolla (when gamopetalous); filaments persistent; anthers ovate, oblong or linear, introrse, basifixed, dehiscing by slits. *Ovary* inferior, 2-locular; placentas axile, bifid, multi-ovulate; style short, thick, simple; stigma massive, oblong-cylindric, often strongly 5-ribbed. Ovules very minute, very numerous, pendulous, anatropous, with 1 integument. *Fruit* baccate, indehiscent. *Seeds* minute, ovoid; testa reticulate, brown; embryo minute; albumen copious.

*Distr.* One genus. From Lower Burma, Indo-China and Kwangtung, throughout *Malaysia* to Central New Guinea–Java and the Lesser Sunda Islands excepted. Fig. 1.

*Ecol.* Damp primary rain-forest, often on rocks by streams, up to 4000 m.

*Uses.* Unimportant, as vegetable or medicine.

*Notes.* The family is a very isolated one. It is possible that there may be a remote connection with the *Campanulaceae*, with which it has long been associated, but the anatomy (see METCALFE in AIRY SHAW, *l.c.*) shows strong affinities with that of the *Begoniaceae*—an affinity also suggested by the asymmetrical leaves—and the habit recalls some of the *Gesneriaceae* (cf. *Cyrtandra*, *Epithema*, etc.) and even *Rubiaceae* (*Argostemma*). It is not at present possible to suggest a satisfactory place for the family in any recognized system.

RIDLEY (*l.c. infra*) states that 'plants with double flowers occur in most, if not all, the species' (of the Malay Peninsula). I cannot confirm this; I have never observed double flowers in *Pentaphragma*.

### 1. PENTAPHRAGMA

WALL. ex G. DON, Gen. Syst. 3 (1834) 731; A. DC. Prodr. 7 (1839) 495; MIQ. Fl. Ind. Bat. 2 (1857) 568; BENTH. & HOOK. f. Gen. Pl. 2 (1876) 558; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1881) 437; BAILLON, Hist. Pl. 8 (1886) 323–4, 358; SCHÖNLAND in E. & P. Nat. Pfl. Fam. 4, 5 (1889) 60; BOERL. Handl. 2 (1891) 257; KING & GAMBLE, J. As. Soc. Beng. 74, 2 (1905) 55; RIDL. Fl. Mal. Pen. 2 (1923) 202; LEMÉE, Dict. Descr. 5 (1934) 134; *op. cit.* Suppl. 9 (1951) 201.

For characters see family description. *Pentaphragma* WALL. ex DC. Mon. Camp. (1830) 95, a superfluous name for *Scaevola*, is a *nomen nudum* and is discarded.

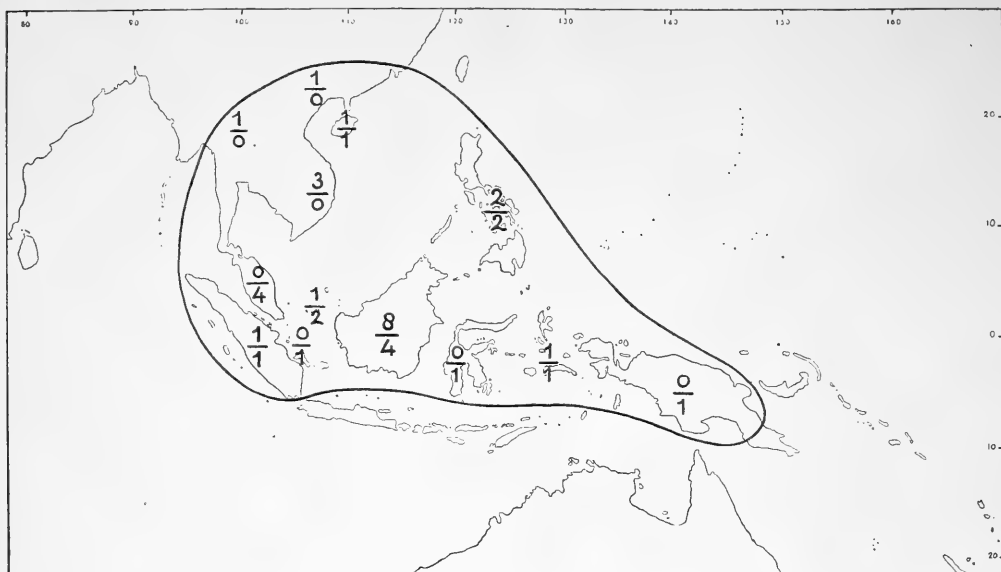


Fig. 1. Distribution of the genus *Pentaphragma*. In each island or island group the figure above the line indicates the number of endemic species, the figure below the line the number of species which are known from more than one island or island group. The corresponding figures from SE. Asia, outside Malaysia, have been derived from literature and are questionable, as the material on which they are based has not yet been revised.—ED.

Distr. About 25 spp. known, with main concentration in Borneo, where many more probably remain to be discovered. It is noteworthy that there are only 7 known Malaysian species which do not include Borneo as at least part of their known area: *P. begoniifolium* (northern Malay Peninsula, extending into Lower Burma and Peninsular Siam); *P. bartlettii* (Sumatra); *P. combretiflorum* (Natuna Isl.); *P. mindanaense* (Philippines); and the three large-flowered species, *P. grandiflorum*, *P. platyphyllum*, and *P. lanuginosum* (Philippines–Moluccas–New Guinea).

#### KEY TO THE SPECIES

1. Stems with conspicuous raised lines or ridges, not caused by shrinkage in drying, running down from the decurrent leaf-bases (inflorescence not distinctly scorpioid).
2. Robust plants, with glossy reddish stems. Inflorescences mostly 3-flowered, densely crispate-pubescent. Flowers large, with elongate calyx-tube. Corolla gamopetalous, fleshy. **4. *P. insigne***
2. Smaller plants, stem not reddish nor conspicuously glossy. Inflorescences 10–12-flowered, almost glabrous. Flowers small, with shortly ellipsoid calyx-tube. Corolla choripetalous, membranous. **11. *P. decurrens***
1. Stems without raised lines from decurrent leaf-bases (or if obscure ridges present then inflorescences distinctly scorpioid).
3. Leaves exceedingly asymmetrical, the shorter side usually concave-excised below and meeting the petiole (or midrib) sometimes 2 cm above the base of the longer side. (Inflorescence at first scorpioid, usually solitary on each stem. Flowers small) **16. *P. begoniifolium***
3. Leaves less asymmetrical, sometimes almost symmetrical, the shorter side never concave.
4. Leaves of a thick, fleshy or leathery texture. Bracts firm, not or scarcely membranous. (Inflorescence 6–10-flowered, subsessile. Flowers rather large. Corolla gamopetalous at least half-way). **7. *P. cyrtandriforme***
4. Leaves not thick and leathery (or if thickish, other characters not as above), mostly papery or membranous when dry. Bracts always ± membranous.
5. Flowers unisexual (♂ only known), delicate in texture. Calyx-tube elongate. Petals very delicate, lingulate, free. Leaves almost symmetrically ovate, subcordate at the base, rounded at the apex. **14. *P. tenuiflorum***
5. Flowers ♂. Corolla ± fleshy or cartilagineous (except in *P. jaherii*). Leaves not cordate or subcordate (except in *P. platyphyllum*).
6. Corolla usually 4-merous. Petals unguiculate-spatulate, almost free, with spreading elliptic limb, pale-margined when dry **13. *P. tetrapetalum***

6. Corolla usually 5-merous. Petals not usually unguiculate-spatulate, limb not conspicuously elliptic and pale-margined.
  7. Corolla delicate in texture (segments free or almost so, externally pubescent). Stem dwarf, 5 cm. (Leaves thickish) . . . . . 15. *P. jaherii*
  7. Corolla  $\pm$  fleshy or cartilaginous. Stem exceeding 5 cm.
  8. Leaves conspicuously cordate at base ( $\pm$  hirsute below, up to 28 by 20 cm. Inflorescence large, lax,  $\pm$  hirsute). Sepals large, rounded, the larger ones 2-2½ by 1½ cm. 2. *P. platyphyllum*
  8. Leaves not (or only slightly and occasionally) cordate at base. Sepals mostly smaller; if as long or longer, then proportionately narrower.
  9. Leaves gradually attenuate-acuminate at the apex, 8-18 by 3-6½ cm. (Inflorescence small.)
  10. Inflorescence lax, rhachis 1-1½ cm long. Upper bracts conspicuous, linear-spatulate. Sepals elongate, oblong-spatulate . . . . . 12. *P. spatulisepalum*
  10. Inflorescence compact,  $\pm$  capitate, rhachis  $\pm$  5 mm long. Upper bracts small, inconspicuous,  $\pm$  elliptic. Sepals small, elliptic . . . . . 19. *P. acuminatum*
  9. Leaves not gradually attenuate-acuminate at apex, at most  $\pm$  abruptly shortly acuminate or cuspidate.
  11. Stems, petioles, midribs (below) and inflorescence-rhachis coarsely long-crispate-lanuginose. (Inflorescence large. Flowers elongate) . . . . . 3. *P. lanuginosum*
  11. Stems, etc., glabrous to crispulous-pubescent, but not coarsely lanuginose.
  12. Flowers very elongate. Calyx-tube 3-8½ cm long . . . . . 1. *P. grandiflorum*
  12. Flowers much less elongate. Calyx-tube not more than 2 cm long.
  13. Calyx-tube 8-20 mm long.
  14. Calyx-tube turbinate-obovoid, 8-10 mm long, densely crispate-pubescent. Inflorescence 2-8-flowered, non-scorpoid. (Leaves sometimes thickish) . . . . . 5. *P. aurantiacum*
  14. Calyx-tube cylindric or ellipsoid or fusiform-lanceolate, 10-15 mm long, shortly pubescent. Inflorescence scorpoid or subscorpoid. Flowers usually more numerous.
  15. Inflorescence usually elongate. Flowers arranged in parallel regular rows. Hypanthia not or scarcely contiguous. Sepals 4-5 by 1-4 mm. Leaves broadly elliptic, practically symmetrical . . . . . 8. *P. combretiflorum*
  15. Inflorescence usually rather robust and dense. Flowers less obviously in parallel rows, calyx-tubes usually contiguous. Sepals 13-15 by 3-8 mm. Leaves broadly elliptic to broadly ovate, slightly but distinctly asymmetrical, rather thin in texture, often drying yellowish . . . . . 6. *P. albiflorum*
  13. Calyx-tube 3-8 (rarely 10) mm long.
  16. Corolla-segments erect, deltoid, acute, not recurved at the apex.
  17. Sepals very broadly elliptic to suborbicular, 4 by 2-4 mm, slightly constricted at base, subconvex. Inflorescence small, subglobose . . . . . 10. *P. bartlettii*
  17. Sepals inconspicuous, recurved, oblong, 2-3 by 1-2 mm, not constricted at base, flat. Inflorescence shortly scorpoid when young, later becoming lax and elongate. . . . . 9. *P. mindanaense*
  16. Corolla-segments  $\pm$  ovate or obovate, often  $\pm$  recurved at apex.
  18. Flowers 5-8 (rarely 10) mm long. Inflorescences usually strongly scorpoid. . . . . 18. *P. horsfieldii*<sup>1</sup>
  18. Flowers 10-15 mm long. Inflorescence dense and compact, scorpoid when luxuriant (20-30-flowered), capitate when few ( $\pm$  10)-flowered. Similar to *P. horsfieldii*, but flowers twice as large . . . . . 17. *P. viride*
- (N.B. Young, few-flowered states of *P. albiflorum* may key out here.)

1. *Pentaphragma grandiflorum* KURZ, Flora 55 (1872) 136 (type: TEYSMANN 5615, from Batjan, Moluccas; Herb. Bogor.!).—*P. macrophyllum* OLIVER, J. Linn. Soc. 15 (1875) 29 (lectotype: MEYER 9, from Geelvink Bay, NW. New Guinea; Herb. Kew.!). F. v. M. Descr. Not. 1 (1876) 28, in obs.; SCHEFFER, Ann. Jard. Bot. Btzg 1 (1876) 181; SCHÖNLAND in E. & P. Nat. Pfl. Fam. 4, 5 (1889) 60; BOERLAGE, Handl. 2<sup>a</sup> (1891) 257; VALETON, Bull. Dép. Agr. Ind. Néerl. no 10 (1907) 68; PULLE, Nova Guinea 8<sup>1</sup> (1910) 407; op. cit. 8<sup>2</sup> (1911) 691; LAM, Nat. Tijd. Ned. Ind. 88 (1928) 213, 218, in obs.; MERR. & PERRY, J. Arn. Arb. 22 (1941) 384.—*P. philippinense* MERRILL, Philip. J. Sc. 2 (1907) Bot. 308 (type: MERRILL 6136, from

Mindoro, Philippines); C. B. ROBINSON, op. cit. 6 (1911) Bot. 227; MERRILL, En. Philip. 3 (1923) 587.—*P. paucinerve* QUIS. & MERR. Philip. J. Sc. 37 (1928) 211.

Stem usually robust, up to 2½ m high and 1 cm thick, glabrous or sparsely pubescent. Leaves  $\pm$  obliquely elliptic, up to 45 by 20 cm, cuneate at base, shortly acuminate or apiculate at apex, shallowly denticulate or serrulate at margin, membranous when dry, glabrous above, finely puberulous to glabrescent below; nerves c. 6 pairs; petiole up to 10 cm, glabrous or puberulous. Inflorescences arising mostly singly from 1-4 upper axils, shortly subscorpoid when young, becoming lax and elongate at anthesis, up to 6

(1) Most segregates of the presumed hybrid *P. × ellipticum* POULS. will also key out here.



(rarely 10) cm, long- or short-peduncled. Bracts very variable, sometimes small and inconspicuous, sometimes large, lanceolate or elliptic, up to 3 by 1 cm. *Flowers* extremely variable,  $3\frac{1}{2}$ –9½ cm long. Calyx-tube subcylindric or very narrowly obconic, 3–8½ cm by 1–4 mm, very gradually attenuate below into the pedicel (and indistinguishable from it until fruit develops), sometimes conspicuously 5-ridged, glabrous or puberulous. *Sepals* very variable, from linear-oblong, 12 by 2 mm, acuminate, to ovate, 29 by 14 mm, subacute or rounded, white. *Corolla* fleshy, choripetalous or almost so, segments elliptic-obovate, 8–12 by 3–5 mm, rounded or acute, glabrous,  $\pm$  erect, often recurved at apex, yellow. Filaments c. 1 mm; anthers c. 2 mm. Style about 2 mm; stigma oblong, 3 by 2 mm, 5-ridged.

*Distr. Malaysia:* Philippines, Moluccas (Bajau, Ceram, Buru), New Guinea.

*Ecol.* Damp primary rain-forest at low and medium altitudes (up to 1000 m), on limestone as well as sandstone; *fl.* & *fr.* throughout the year.

*Uses.* A recent Philippine collector suggests (*in sched.*) that the flowers are sufficiently showy to render the plant suitable for ornamental purposes.

*Vern.* Bugaong, handanata, pitun, saling-bangung, Philippines, nina kope, Ceram.

*Notes.* Examination of a rather extensive series of specimens from the Philippines and W. New Guinea, and of a smaller number from the Moluccas, has convinced me that it is at present impossible to recognize more than one, very variable, species within this group. Certain local tendencies are perceptible, such as great elongation of the hypanthium, reduction of indumentum and narrowing of sepals in New Guinea, and rounding of sepals and greater development of pubescence in the Philippines, but the variations seem to be quite continuous and uncorrelated, and it is impossible to fix lines of demarcation between the three species hitherto recognized. KURZ's somewhat neglected species provides the earliest name for the group in the aggregate.

The eastern limit of the species in New Guinea appears almost to coincide with the boundary of Indonesian territory, since, although it has been collected many times to the west of this line, the only evidence for its occurrence east of it rests upon two specimens from the Fly River, collected both by d'ALBERTIS in 1877 (in Herb. BECCARI) and by BRASS in 1936 (cited by MERRILL & PERRY, *l.c.*, 1941).

**2. *Pentaphragma platyphyllum* MERR.** Philip. J. Sc. 17 (1920) 322; En. Philip. 3 (1923) 587.

Stem robust, up to 50 cm long, densely crispate-pubescent on the younger parts. *Leaves* large, broadly ovate to elliptic-ovate, slightly oblique, up to 28 by 20 cm, base cordate, apex very shortly triangular-cuspidate, subacute, margin rather distinctly and shallowly denticulate, papyraceo-chartaceous when dry, glabrous above, thinly crispate-strigose below (densely when young), especially along the nerves; nerves 5–6 pairs; petiole up to 10 cm. *Inflorescences* apparently arising singly

ly in 2–3 upper axils, pubescent, up to 8 cm long. Bracts narrowly oblong, up to 1 cm. Pedicels about 1½ cm. Calyx-tube slender, elongate, up to 3 cm, terete or obscurely angled,  $\pm$  pubescent. *Sepals* elliptic, the two larger 2–2½ by 1½ cm, the remainder about half as large, rounded, white. *Petals* oblong to narrowly oblong-obovate, c. 10 by 5–6 mm, rounded, fleshy.

*Distr. Malaysia:* Philippines.

*Ecol.* Primary rain-forest along small streams at low altitudes; *fl.* May.

*Notes.* Distinguished from the closely related *P. grandiflorum* and *P. lanuginosum* principally by its cordate-based leaves.

**3. *Pentaphragma lanuginosum* AIRY SHAW, Kew Bull. (1953) 241.**

Stem robust, but of unknown stature, 7–12 mm thick in upper part, shaggy. *Leaves* obliquely obovate, 25–35 by 12–17 cm, base cuneate, apex rounded to subacute, usually very shortly apiculate-acuminate, margin denticulate often revolute, membranous when dry, glabrous above, shortly hispidulo-pubescent below,  $\pm$  conspicuously crispulous-shaggy along the midrib and larger nerves; nerves c. 6 pairs; petiole robust, 3–5½ cm by 4–8 mm, strongly crispulous-shaggy. *Inflorescences* arising singly from 1–2 upper axils, at first subscorpioid, soon becoming lax and elongate, 10–12 cm long, 10–20-flowered; peduncle 1½–2 cm, rhachis up to 7 cm, both shaggy. Bracts broadly ovate to oblong, acute, 10–15 by 3–10 mm, membranous, puberulous on the back. *Flowers* large, up to 6–7 cm long. Calyx-tube elongate, very narrowly obconic, very gradually widened upwards, 4–5 cm by 3–5 mm, crispulous-floccose. *Sepals* narrowly or broadly ovate, 13–17 by 4–12 mm, acute, membranous, sparsely crispulous-floccose on the back, otherwise glabrous. *Corolla* apparently choripetalous, or exceedingly shortly gamopetalous, fleshy,  $\pm$  crispulous-floccose outside; segments oblong-elliptic, c. 12 by 5 mm, subacute, margins inflexed. Filaments  $\pm$  2 mm; anthers linear,  $\pm$  3 mm, acute. Style thick, 2–3 mm; stigma cylindric, 5-ribbed, 3 by 1½ mm.

*Distr. Malaysia:* Moluccas (Sula Islands: Taliabu); once collected.

*Notes.* Distinguished from the closely related *P. grandiflorum* and *P. platyphyllum* by the dense shaggy indumentum.

**4. *Pentaphragma insigne* AIRY SHAW, Kew Bull. (1953) 241.**

Stature unknown, probably 60 cm or more; stems robust, up to 12 mm thick, fistular, glabrous, glossy, dark red when dry, conspicuously costate-winged from the long imbricate-decurrent petiole-bases, wings 1–2 mm wide. *Leaves* broadly ovate to broadly elliptic, slightly oblique, 17–22 by 8–11½ cm,  $\pm$  rounded to broadly cuneate at base, broadly acute at apex, passing into a cusp or short acute acumen, margin rather coarsely crenate-dentate, firmly papyraceous when dry, glabrous above, densely shortly hispidulo-pubescent below; nerves 3–5 pairs; petiole (free part)

1½–2½ cm by 3–4 mm, almost glabrous. *Inflorescences* arising singly from 3–4 middle or upper axils, mostly 3-flowered, erect; peduncle 3–4 mm, densely crispate-pubescent. Bracts ovate-lanceolate, up to 18 by 7 mm, much attenuate upwards, acute, crispulo-pubescent outside, glabrous and shining within; pedicels 1–2 mm. Calyx-tube elongate-fusiform or almost cylindric, 15 by 2–4 mm, striate, densely crispulo-pubescent. *Sepals* rather small, subspatulate-ellipsoid, 8–10 by 2–3 mm, obtuse, slightly papillose-puberulous on the back, separated by broad rounded sinuses. *Corolla* widely cup-shaped, 6 mm long, gamopetalous for 1/3 or 1/2, firmly fleshy, segments ovate-deltoid, ca 4 mm wide at base, acute at apex, margin entire narrowly pale-cartilaginous. Filaments 3½–4½ mm; anthers lanceolate, attenuate at apex, acute, 3½ mm, linear after dehiscence. Style thick, 3 mm; stigma oblong, 3 by 1½ mm, obscurely 5-grooved.

*Distr. Malaysia:* Borneo (Sarawak); once collected.

*Ecol.* Primary rain-forest, on sandstone, between 450 and 900 m; *fl.* May.

*Notes.* This is certainly nearest to *P. aurantiacum* STAPF, but differs strikingly in the stem being prominently ridged and almost winged from the decurrent petiole-bases, and in the narrowly fusiform or cylindric calyx-tube.

**5. *Pentaphragma aurantiacum* STAPF**, Trans. Linn. Soc. 4 (1894) 188; RIDL. J. Str. Br. R. As. Soc. no 63 (1912) 60; MERR. EN. BORN. (1921) 585.—*P. grande* RIDL. J. Linn. Soc. 38 (1908) 312; Fl. Mal. Pen. 2 (1923) 203; AIRY SHAW, Kew Bull. 1941, 235 (1942).—*P. pulgarensse* ELMER, Leaflet. Philip. Bot. 8 (1915) 2572; MERR. EN. Philip. 3 (1923) 587.—*P. obtusifolium* MERR. Sarawak Mus. J. 3 (1928) 556.

Stem robust, up to 90 by 1.2 cm, sparsely puberulous above, otherwise glabrous, sometimes conspicuously lenticellate. *Leaves* obliquely ovate, 11–22 by 6–13 cm, cuneate to truncate-rounded at base, very shortly cuspidate-acuminate at apex, margin closely undulate-denticulate, often reflexed and then appearing entire, membranous and somewhat translucent when dry, glabrous above, scatteredly hispidulous-pubescent below; nerves 2–4 pairs, usually densely crispulo-puberulous below; petiole 2–6 cm, puberulous or glabrescent. *Inflorescences* 1–3 on each stem, from the upper axils, 2–8-flowered; peduncle 5–8 cm, pubescent. Lower bracts broadly ovate, about 10 by 7 mm, acute, coarsely papillose, upper ones smaller and narrower. *Flowers* large, nearly 2 cm long, very shortly pedicelled. Calyx-tube turbinate-obovoid, 8–10 mm long, densely crispate-pubescent. *Sepals* broadly or narrowly oblong, 6–8 by 2–5 mm, obtuse, reticulate-nerved, crispulo-pubescent outside, almost glabrous within. *Corolla* 2–2½ cm across when expanded, slightly or scarcely fleshy, sympetalous for 1/3 or more, very sparsely puberulous outside, segments broadly obovate, 7–8 mm wide, subacute, junction of adjacent segments marked internally by double thickened suture. Filaments flattened, 3 mm long;

anthers oblong, 2 mm. Style very short, stigma 3 mm long, cylindric-pentagonal. *Fruit* turbinate-obovoid, 10 by 5–6 mm, densely crispate.

*Distr. Malaysia:* Malay Peninsula, Borneo (NE. Sarawak & Mt Kinabalu), Philippines (Palawan).

*Ecol.* Primary rain-forest, and upper dwarfed forest, 1500–2700 m; *fl. & fr.* March–April, June–September, December. Apparently not infrequent on Kinabalu.

*Notes.* The form described by RIDLEY as *P. grande* differs from the type of *P. aurantiacum* in its apparently more opaque and thickly coriaceous leaves, with shorter hairs on the lower surface. This form has, however, also been gathered on Mt Kinabalu (between Kamburungan and Paka, 2700 m, CLEMENS 28999), and as it appears to show no significant differences in floral structure it seems preferable to consider it for the present as a form of *P. aurantiacum*.

The range in flower colour is noteworthy, various collectors giving it as bright red with green sepals, orange, salmon yellow with green throat, yellow, and dirty white. It is possible that this sequence corresponds to the progressive age of the flowers.

The species is characterized by its generally robust habit and short, non-scorpioid inflorescences of large, somewhat turbinate, densely crispate-pubescent flowers.

**6. *Pentaphragma albiflorum* H. H. W. PEARSON** in Hook. Ic. Pl. 28 (1901) t. 2706; MERR. EN. BORN. (1921) 585.

Stem robust, up to 60 cm high, mostly glabrous or glabrescent and lenticellate, but sparsely crispate-pubescent on the young parts. *Leaves* broadly elliptic to broadly ovate, slightly oblique, 11–24 by 5½–13 cm, cuneate-attenuate at base, acute and very shortly acuminate or cuspidate at apex, obtusely sinuate-denticulate or undulate-serrate, glabrous above, shortly and sparsely hispidulous-pubescent below, more densely so on the nerves; nerves 3–4 pairs; petiole 2½–5 cm, shortly hispidulous or glabrescent. *Inflorescences* robust, shortly scorpioid, arising singly (? rarely 2 together) from 1–5 upper axils, 3–6 cm long, rather densely and shortly crispate-pubescent; peduncle 5–10 mm. Lower bracts oblong-ovate, up to 2 by 1 cm, membranous, minutely hispidulous, upper ones gradually diminishing in size. Pedicels 0–2 mm long. *Flowers* large, c. 2 cm long at anthesis, but rapidly elongating to c. 3 cm in fruit. Calyx-tube narrowly fusiform-lanceolate, c. 10 by 2–3 mm, attenuate above, shortly pubescent. *Sepals* large, membranous, oblong-elliptic, c. 13–15 by 3–8 mm, rounded-obtuse, erose-denticulate, sparsely to densely crispate-pubescent outside. *Corolla* 6–7 mm long, gamopetalous to c. 1/3, segments ± lanceolate or narrowly triangular, c. 3 mm wide at base, apex acute, spreading but not usually strongly reflexed, ± fleshy. Stamens about 3 mm long; anthers oblong, apparently often abortive. Style thick, 2–3 mm; stigma oblong, pentagonal, 2 mm long. *Fruit* ellipsoid, 15–20 by 3–5 mm, ± crispate-pubescent.

Distr. *Malaysia*: Natuna Islands (Bunguran), Borneo (W. Borneo, Sarawak, N. Borneo), ?Philippines (Palawan), ?Celebes.

Ecol. Primary rain-forest; at 600 m on Mt Ranai in Bunguran, at 3–4000 m on Mt Kinabalu; fl. & fr. April–May, Aug.–Sept., Nov.

Notes. The principal features of this species appear to be the rather large,  $\pm$  ferrugineous-pubescent, shortly scorpioid inflorescences, large flowers, and large membranous sepals with rounded tips. The foliage varies considerably, but often dries a pale yellowish brown. The illustration of the inflorescence in HOOKER's Ic. Pl. is misleading, in showing apparently rotate corollas; the dissection (*l.c.* fig. 2), however, is correct.

A plant that has twice been collected in SW. Central Celebes (RACHMAT 581 and KJELLBERG 1757a, both in Herb. Bogor.) possibly represents a small-flowered form of *P. albiflorum*, but further collections are required in order to decide its status. It is the only *Pentaphragma* so far known from Celebes.

**7. *Pentaphragma cyrtandriforme* AIRY SHAW, Kew Bull. (1953) 242.**

Stem 10–20 cm long,  $\pm$  prostrate. *Leaves* broadly elliptic to ovate, slightly oblique or almost symmetrical, 8–25 by 5–13 cm, base cuneate or rounded or slightly truncate-cordate, apex rounded or subacute, margin usually very closely sinuate-denticulate-crenulate, sometimes revolute and then apparently subentire, glabrous above, rather furfuraceous below (occasionally glabrescent between the nerves), coriaceous-fleshy when dry, mostly grey-olive above, pale ochraceous beneath; nerves 3–7 pairs; petiole  $2\frac{1}{2}$ –13 cm, mostly elongate. *Inflorescences* arising singly or in pairs from upper axils, capitate, not or scarcely scorpioid,  $1\frac{1}{2}$ –4 cm in diam., 6–10-flowered; peduncle up to 1 cm, sometimes almost absent. Bracts broadly elliptic, mostly herbaceous, the lowest 10–18 by 6–7(–12) mm, acute. *Flowers* 1–2 cm long, or sometimes up to 3 cm. Calyx-tube obovoid or ellipsoid, 8 by 2–3 mm, or sometimes narrowly fusiform, up to 2 cm by 3–4 mm, angled. *Sepals* elliptic, very unequal, 8–13 by 3–6 mm, subacute. *Corolla* gamopetalous, 7–10 mm long, tube urceolate-campanulate, 4–7 mm long, segments revolute,  $2\frac{1}{2}$ –3 mm wide. Stamens 4 mm long; anthers subulate. Style thick, stigma pentagonal-cylindric 2–3 by 1 mm. *Fruit* ellipsoid, up to 15 by 7 mm.

Distr. *Malaysia*: Malay Peninsula (Trengganu, Pahang), Borneo.

Ecol. Primary rain-forest up to 1800 m; fl. & fr. March, June–Sept., Nov., Dec.

Notes. The thick, fleshy-coriaceous, often densely crenulate-denticulate leaves, and the sessile inflorescences of few, rather large flowers, with large, firm, not or scarcely membranous bracts, are characteristic of this species. The more or less prostrate stem, often long-petioled leaves, and capitate, sessile inflorescence, are suggestive of some of the *Gesneriaceae-Cyrtandroideae*. The species has been described from almost a dozen collections, and shows some variation; it is

possible that the material from SE. Borneo may even be distinct, but it seems preferable for the present to include it within the species.

**8. *Pentaphragma combretiflorum* AIRY SHAW, Kew Bull. (1953) 243.**

Stature unknown; stems robust below, up to 9 mm thick, smooth, glabrous except for the sparsely crispulo-pubescent young parts, leafy. *Leaves* very broadly elliptic or obovate-elliptic, hardly asymmetrical, 13–19 by 7–13 $\frac{1}{2}$  cm, base cuneate-attenuate, rarely  $\pm$  rounded, sometimes slightly unequal-sided, apex very broadly cuspidate-acuminate, margin very shortly undulate-denticulate, thinly papery in texture when dry, glabrous above, very shortly and sparsely papillose-hispidulous or almost glabrous below, quintuplinerved or rarely septuplinerved; petiole 3–5 $\frac{1}{2}$  cm, slender, glabrous. *Inflorescences* arising singly or two together from 4 of the upper axils, shortly or rather elongate-scorpioid, 1–3 $\frac{1}{2}$  cm long, 4–20-flowered, flowers elongate, arranged very regularly, parallel, recalling the inflorescence of some *Combretum*; peduncle 7–8 mm long, crispulo-puberulous; bracts small in proportion, ovate, 5–7 by 3–5 mm, the lowest one sometimes larger, up to 12 mm long, membranous, ciliate, puberulous on the back; pedicels none. *Flowers*  $1\frac{1}{2}$ –2 cm long. Calyx-tube at first almost cylindric, then narrowly fusiform-lanceolate, almost rostrate, 11–13 by 1–3 mm,  $\pm$  pentagonal, striate, sparsely puberulous. *Sepals* oblong-ovate or oblanceolate, 4–5 by 1–4 mm rounded, membranous, puberulous on the back. *Corolla* campanulate, gamopetalous for more than  $\frac{1}{2}$  (later more deeply split), 6 mm long, 5 mm wide, sparsely or rather densely crispate-puberulous outside, segments oblong or ovate, erect, subcarinate on the back, acute or subacute and recurved at apex. Filaments  $2\frac{1}{2}$  mm; anthers narrowly linear-lanceolate,  $1\frac{1}{2}$  mm, acutely apiculate. Style 2 mm; stigma oblong, pentagonal, 2 mm long. Mature *fruit* not seen; young fruit fusiform-lanceolate, 13 by 4 mm. Seeds dark chestnut, apparently completely immersed in placentar tissue.

Distr. *Malaysia*: Natuna Islands (Bunguran); twice collected.

Ecol. Stated to be frequent in primary forest at ca 600 m; fl. April–May.

Notes. The almost symmetrical, broadly elliptic leaves, and subscorpioid cymes of elongate parallel flowers, render this a very distinct species.

**9. *Pentaphragma mindanaense* MERRILL, Philip. J. Sc. 20 (1922) 472; En. Philip. 3 (1923) 587.**

Stems up to 50 cm by 5–10 mm, conspicuously crispulo-pubescent in younger parts. *Leaves* obliquely elliptic-lanceolate or elliptic-ovate or almost regularly elliptic, 15–23 by 6–9 cm, broadly cuneate at the base, narrowed to the obtuse apex, entire or most obscurely undulate-crenate, membranous, glabrous above, sparsely crispulo-puberulous below (rather densely on the nerves); nerves 4–5 pairs; petiole 2–3 cm long, pubescent. *Inflorescences* arising 1–3 together from 1–3 upper

axils, shortly scorpioid when young, elongating and scarcely scorpioid at anthesis, up to 10–12-flowered, 2–5 cm long including 1–1½ cm long pubescent peduncle. Bracts inconspicuous, elliptic or subspatulate, 7–10 by 3–4 mm, obtuse, membranous, ciliate. Pedicels 1–2 mm. *Flowers* 8–10 mm long. Calyx-tube obconic or oblong or ellipsoid, attenuate into the pedicel, 6–8 by 3–4 mm, crispulo-puberulous. *Sepals* small and inconspicuous, oblong, 2–3 by 1–2 mm, membranous, obtuse, puberulous, recurved. *Corolla* shortly and widely campanulate, 3–4 mm long, fleshy, gamopetalous for 1–2 mm; segments deltoid, 2 mm long, 1½–2 mm wide at base, acute, ± erect. Filaments *c.* 2 mm; anthers not seen. Style very short and thick; stigma conical-pileiform, 1.3 mm diam. *Fruit* broadly ellipsoid, 9 by 5 mm.

*Distr. Malaysia:* Philippines (Mindanao); twice collected.

*Ecol.* By small streams in forests at low altitudes; *fl.* & *fr.* Oct.–Nov.

*Notes.* The small recurved sepals and erect, acute, deltoid corolla-segments, suggesting a 5-pointed crown, are characteristic of this species.

**10. *Pentaphragma bartlettii* MERRILL, Pap. Mich. Acad. Sc. 19 (1934) 201.**

Stem up to 70 cm high, upper part ± hispidulopileous, the young parts rather densely crispate-pubescent. *Leaves* broadly ovate or broadly elliptic, slightly oblique, 18–25 by 9–12 cm, rounded to cuneate-attenuate at base, ± rounded or narrowed and very shortly cuspidate-acuminate at apex, margin closely crenulate, often ± bullate, glabrous above, very shortly and rather densely hispidulo-puberulous below; nerves *c.* 5 pairs; petiole 2½–4½ cm, hispidulous. *Inflorescences* small, subglobose-capitate, arising singly or in pairs from 2–3 upper axils, 1½–2½ cm diam., often dark brown when dry, very shortly pedunculate. Lower bracts ovate, acute, *c.* 10 by 5 mm, papillose-puberulous on the back. Pedicels almost none. Calyx-tube obconic, *c.* 5–6 by 3–4 mm, shortly crispate-puberulous. *Sepals* very broadly ovate-elliptic or suborbicular, 4 by 2–4 mm, slightly constricted at the base, broadly rounded at the apex, margins quite entire and slightly reflexed and hence subconvex, glabrous, or puberulous on the back towards the base. *Corolla* *c.* 4 mm long, shortly (1 mm) gamopetalous, slightly fleshy, segments deltoid, acute, erect, 2 mm broad at base, margins slightly thickened and slightly involute below the apex. Stamens not seen. Style *c.* 1 mm; stigma discoidally expanded. *Fruit* ellipsoid-obovoid, *c.* 10 by 5 mm.

*Distr. Malaysia:* Sumatra; several times collected.

*Ecol.* Damp places and tuff cliffs in primary forest, up to 1850 m; *fl.* & *fr.* April–May, Nov.–Dec.

*Notes.* Characterized by the elongate stem, frequently bullate leaves, rather small subglobose inflorescences often drying dark brown, entire, glabrous, suborbicular sepals, and erect, deltoid-acute corolla-lobes.

**11. *Pentaphragma decurrens* AIRY SHAW, Kew Bull. (1953) 244.**

Stem 15–20 cm by 4–6 mm, smooth, glabrous, marked with 4–5 conspicuous raised lines from the decurrent petiole-bases. *Leaves* broadly ovate-elliptic, slightly oblique, 20–21 by 9–11 cm, cuneate-attenuate at base, narrowed and acute (sometimes shortly subacuminate) at the apex, margin very obscurely denticulate or subentire, rather thick in texture, quite glabrous; nerves 4–5 pairs; petiole 1½–2½ cm by 2–4 mm, apparently acutely keeled on the back, glabrous, conspicuously decurrent. *Inflorescence* apparently single on each stem, arising from an upper axil, not or scarcely scorpioid, 3–4 cm long, 10–12-flowered, glabrous except for the ciliolate bracts and sepals. Lower bracts 12–14 by 4–7 mm, elliptic, acuminate, subentire or sparsely ciliolate, submembranous, the upper ones smaller and more strongly ciliolate. Peduncle *c.* 1½ cm. Pedicels almost absent. Calyx-tube shortly ellipsoid-ovoid, 5 by 2–3 mm, ± angled, glabrous. *Sepals* subspatulate-elliptic, 4–5 by 2–2½ mm, not very unequal, rounded at apex, erose-ciliolate, separated by rounded sinuses. *Corolla* known only from buds and damaged open flowers, apparently almost choripetalous; segments elliptic-obovate, 3–4 by 1½–2 mm, thinly petaloid in texture (not fleshy), the margins ± induplicate-valvate in bud, apparently soon falling or broken off. Stamens known only from the bud: filaments very short; anthers ovate, apiculate, 1–1½ mm long. Style very short; stigma shortly pentagonal-cylindric, *c.* 1 mm long. *Fruit* shortly oblong, 8 by 4 mm.

*Distr. Malaysia:* Borneo (Sarawak); several times collected.

*Ecol.* Unknown, but doubtless rain-forest; *fl.* Aug.

*Notes.* Very distinct in the raised decurrent lines on the stem (the only other known species showing this feature being the very different *P. insignis* AIRY SHAW) and in the petaloid texture of the apparently almost free corolla-segments, which are more or less induplicate-valvate in bud.

**12. *Pentaphragma spatulisepalum* AIRY SHAW, Kew Bull. (1953) 245.**

Stem 10–20 cm long, slender, glabrous. *Leaves* subfalcately elliptic or ovate, 11–18 by 5–6½ cm, cuneate-attenuate at base, attenuate, subacuminate and acute at apex, margin undulate-serrate, very thin in texture, quite glabrous; nerves 2–4 pairs; petiole very slender 1.3–2 cm. *Inflorescences* arising singly from the 1–3 uppermost axils, 6–12-flowered, rather lax, not scorpioid at anthesis, 2–3 cm diam.; rhachis up to 1½ cm; peduncle 5 mm, minutely ramentaceous-hispidulous. Bracts linear-spatulate (except for the lowest which is elliptic-oblong), *c.* 10 by 1–2 mm, attenuate at the base into a 2–3 mm long petiole, obtuse or emarginate at apex, membranaceous, glabrous. Pedicels slender, 2–3 mm, glabrous. *Flowers* 8–10 mm long, glabrous. Calyx-tube narrowly ellipsoid, 4–5 by 1–2 mm. *Sepals* spatulate-oblong, 5–6 by 1½–2 mm, obtuse or retuse, erect or slightly

patent, less unequal than in most species. *Corolla* 4–5 mm long, gamopetalous to beyond the middle; segments oblong-ovate, 1.3 mm wide, subobtuse, erect, recurved at apex. Filaments c. 2 mm; anthers oblong, 1 mm. Style  $1\frac{1}{2}$  mm; stigma thickly pentagonal-discoid, 1 by 0.8 mm, 5-lobulate. *Fruit* ellipsoid, 7–8 by 3–4 mm, attenuate at base.

*Distr. Malaysia:* Borneo (Sarawak); twice collected.

*Ecol.* Unknown, but probably primary rain-forest; *fl. & fr.* August.

*Notes.* In foliage scarcely distinguishable from *P. acuminatum* AIRY SHAW, but differing strongly in the lax inflorescence with elongate rhachis, conspicuous linear-spatulate upper bracts, and elongate oblong-spatulate sepals.

**13. *Pentaphragma tetrapetalum* AIRY SHAW, Kew Bull. (1953) 246.**

Stem c. 10 cm high, glabrescent below, crispate-setulose above. *Leaves* obliquely broad-ovate, 13–19 by 8–11 cm, rather broadly cuneate at base, almost rounded at apex and narrowed into a very short subacute cusp (sometimes almost absent), very obscurely shallowly sinuate-crenulate, glabrous above, shortly pubescent on the nerves below; nerves 2–4 pairs; petiole slender, 2–3 cm, glabrescent. *Inflorescences* arising singly from 1–2 of the upper axils, shortly and densely scorpioid,  $2\frac{1}{2}$ –3 cm long, c. 12–14-flowered, peduncle 5–10 mm. Lower bracts broadly elliptic-ovate, c. 8 by 6–8 mm, membranous, pubescent, the upper ones smaller. Pedicels almost none. Calyx-tube ellipsoid, 3 by  $1\frac{1}{2}$  mm, pubescent. *Sepals* 5, obovate or spatulate-obovate, c. 5 by 2–3 mm, obtuse, membranous, hispidulous, ciliolate. *Corolla segments* 4, rarely 5, almost free or very shortly connate at base, unguiculate-spatulate, the 'claw' erect, broadly oblong, 2 mm, the 'limb'  $\pm$  spreading or recurved,  $\pm$  flat or somewhat twisted, broadly elliptic, 3 by  $2\frac{1}{2}$  mm, subacute, margin quite entire and conspicuously pale when dry, as though cartilagineous. Filaments slender, 1 mm, anthers linear, 2 mm. Stigma sessile or subsessile, thickly pileiform or subcerebriform or excavated at the summit, 1 by  $1\frac{1}{2}$ –2 mm. *Fruit* ellipsoid, 8–10 by 3–4 mm, sparsely pubescent.

*Distr. Malaysia:* N. Borneo; twice collected.

*Ecol.* Unknown; probably rain-forest; *fl. & fr.* Aug.

*Notes.* Very distinct in its usually 4-merous corollas, almost free unguiculate-spatulate petals with flattish spreading pale-margined limb, and (? always) subsessile pileiform stigma.

**14. *Pentaphragma tenuiflorum* AIRY SHAW, Kew Bull. (1953) 246.**

Stem 15 cm by 7 mm, glabrous except for the young parts. *Leaves* elliptic-ovate or ovate,  $9\frac{1}{2}$ –16 by 7–10 cm, truncate-rounded or subcordate at base, obtuse or  $\pm$  rounded at apex, margin very closely and finely undulate-crenulate, rather thick, glabrous above, minutely and remotely hispidulous below, nerves densely crispulo-puberulous; nerves 3–4 pairs; petiole 4–6 cm. *Inflorescences*

apparently arising up to 4 together from 3–4 upper axils, ca 4-flowered, apparently weak. *Flowers* elongate, congested at the apex of the  $1\frac{1}{2}$ –2 cm long peduncle. Bract at middle of peduncle oblong-elliptic, 10–12 by 5 mm, shortly acuminate, bracts subtending flowers broadly ovate-elliptic or spatulate-elliptic, 15 by 9 mm or 15 by 6–7 mm or 10–11 by 3 mm, acute or rounded, papillose or glabrous on back, margin ciliolate. *Flowers* apparently dioecious, males only known, erect (?),  $2\frac{1}{2}$  cm long. Calyx-tube elongate, cylindric, 1.6–1.9 cm by 2–3 mm, very shortly and sparsely pilose. *Sepals* ovate-elliptic or oblong-elliptic, 8–9 by 3–5 mm, rounded or obtuse, minutely sparsely ciliolate, membranous. *Petals* free, lingulate, 8–9 by  $1\frac{1}{2}$ –1.8 mm, obtuse, delicate or 'petaloid' in texture,  $\pm$  induplicate-valvate in bud. Stamens very short: filaments 1– $1\frac{1}{2}$  mm; anthers oblong, slightly incurved, thick, 2 mm. No trace of ovary or style. Female flowers and fruit unknown.

*Distr. Malaysia:* Borneo (Sarawak); once collected.

*Ecol.* Unknown, but doubtless rain-forest; *fl.* May.

*Notes.* This is the only dioecious *Pentaphragma* known. The free petals, of delicate texture and with infolded margins in bud, resemble in these respects those of *P. decurrens* and *P. jaherii*, but are longer and narrower in proportion, and the three species are not otherwise similar. More ample material of *P. tenuiflorum* is very desirable.

**15. *Pentaphragma jaherii* AIRY SHAW, Kew Bull. (1953) 247.**

Stem dwarf, 5 cm by 3–4 mm,  $\pm$  densely crispulo-pubescent above. *Leaves* subfalcately ovate-lanceolate,  $7\frac{1}{2}$ –9 by  $3\frac{1}{2}$ – $4\frac{1}{2}$  cm, rounded or subcordate at base, gradually narrowed into the subobtuse or subacute apex, margin narrowly revolute, apparently entire but probably actually very minutely crenulate, thickish in texture, distinctly rounded-papillose below, glabrous except for the nerves sparsely puberulous below; nerves 3–5 pairs; petiole slender, 8–13 by 2 mm, puberulous. *Inflorescence* apparently solitary on each stem, arising from a subterminal axil, compact, scarcely evidently scorpioid, 2 cm diam.; peduncle 1 cm, pubescent. Bracts rather large in proportion, broadly ovate or suborbicular, up to 10 by 8 mm, membranous, crispulo-puberulous, conspicuously laciniate-ciliate or fasciculate-pilose on the margin. *Flowers* 9–12 mm long. Calyx-tube campanulate or oblong-ovoid, 4–6 by 3–4 mm, puberulous. *Sepals* very unequal: smallest one oblong-elliptic, 4 by  $1\frac{1}{2}$  mm, largest suborbicular, 4–5 mm diam.; remainder intermediate; all membranous, crispulo-puberulous, erose-ciliate. *Petals* free (or possibly arising from a membranous annulus?), elliptic-oblong, 4 by  $1\frac{1}{2}$  mm, delicate in texture, margins inflexed, subcucullate at apex, crispulo-puberulous on back. Filaments  $1\frac{1}{2}$  mm; anthers linear, 1 mm. Style broadly conical, 1 mm long; stigma conical, 1 mm long.

*Distr. Malaysia:* Central Borneo, once collected.

Ecol. Primary rain-forest on sandstone mountain.

Notes. Spirit material is particularly necessary for the proper examination of species with delicate corollas, such as this. *P. jaherii* differs from the other two known Malaysian species possessing this character, *P. decurrens* and *P. tenuiflorum*, especially in the unusual feature of the petals being externally pubescent. In these features, however, it agrees with *P. gamopetalum* GAGNEP., of Annam, a species differing in its taller habit, larger, thinner, denticulate leaves and larger flowers. GAGNEPAIN appears to have misinterpreted the corolla of *P. gamopetalum* (cf. Fl. Gén. I. C. 3, 1930, 696, f. 79, 1-2). Dissection of the type showed 5 free or almost free, delicate, narrowly oblong-elliptic petals, as in *P. jaherii*, *P. decurrens* and *P. tenuiflorum*.

**16. *Pentaphragma begoniifolium* (ROXB. ex JACK) WALL. [Cat. (1829) 1313\*] ex G. DON, Gen. Syst. 3 (1834) 731; A. DC. Prod. 7 (1839) 496; MIQ. Fl. Ind. Bat. 2 (1857) 568; HOOK. f. & THOMS. J. Linn. Soc. 2 (1858) 26; KURZ, J. As. Soc. Beng. 46, 2 (1877) 210; CLARKE in HOOK. f. Fl. Br. Ind. 3 (1881) 437; BAILL. Hist. Pl. 8 (1886) 358, in adnot.; RIDL. Trans. Linn. Soc. 3 (1893) 315; CURTIS, J. R. As. Soc. Str. Br. no 25 (1894) 113; RIDL. op. cit. no 33 (1900) 103; RIDL. Fl. Mal. Pen. 2 (1923) 202, f. 90; BURKILL & HANIFF, Gard. Bull. Str. S. 6 (1930) 218; BURKILL, Dict. 2 (1935) 1691; KERR, Fl. Siam. En. 2 (1936) 308.—*Phyteuma begoniifolium* ROXB. [Hort. Beng. (1814) 85, nomen] ex JACK, Mal. Misc. 1 (1820) no 1, 5; in HOOK. Bot. Misc. 1 (1830) 276, t. 57; ROXB. Fl. Ind. ed. CAREY 1 (1832) 505.—*P. begonioides* BAILL. Hist. Pl. 8 (1886) 324-5, f. 152-4.**

Stem 10-25 cm long, simple or rarely with 1 or 2 branches, thinly crispate-floccose, especially above. Leaves very 'begonia-like', exceptionally asymmetrical, obliquely ovate to obliquely lanceolate or oblong or even obliquely reniform or subcylindrical, 10-30 by 6-13½ cm, base rounded or cordate on the longer side, strongly excised-concave on the shorter side, apex narrowed to a very short acute acumen or cusp, margin strongly and sharply but shallowly serrate, sparsely crispate-puberulous below (densely so when young), glabrous above; nerves flabellately arranged, straight or little curved; petioles 2-4 cm, crispate-puberulous. Inflorescence terminal or subterminal (rarely lower), solitary (very rarely 2-4) on each stem, at first dense and scorpioid, ultimately lax and almost straight, 4-5 cm long; peduncle 1-2 cm, crispate-floccose, often bearing a ± leafy bract midway. Bracts subtending the flowers orbicular-obovate, rounded at apex, membranous, 5-9 mm long. Flowers biserial, 8-9 mm long. Calyx-tube obovoid, 4-5 by 3 mm, sparsely pilose. Sepals unequal, ovate to orbicular, 2-2½ mm long, margins often revolute, membranous, pilose or glabrescent on both surfaces. Corolla shortly (1

mm) gamopetalous, 3 mm long, slightly fleshy, glabrous, segments spatulate-obovate, rounded, erect, recurved at apex. Filaments 1 mm; anthers ovate, shortly acuminate, 1 mm long. Stigma massive, cylindric-pentagonal, 1 mm long. Fruit ellipsoid, 8-9 by 3-4 mm.

Distr. Lower Burma, Peninsular Siam; in Malaysia: northern part of Malay Peninsula.

Ecol. Evergreen rain-forest, often on rocks by streams, up to 600 m; fl. Feb.-April (June-Aug. in Siam).

Vern. *Salang suang* (? = *balong ayam*), Perak.

Uses. Poulitce from roots applied to swellings.

Notes. *P. begoniifolium*, the type-species of the genus, is immediately recognizable by its exceptionally oblique leaves. The superior ovary shown in the dissected flower in the illustration in RIDLEY'S Flora (l.c.) is, of course, erroneous.

**17. *Pentaphragma viride* STAPF & GREEN, J. Linn. Soc. 42 (1914) 100; MERR. En. Born. (1921) 585.—*Francfleuria hosei* GAGNEP. Rev. Bot. Appl. 7 (1927) 665.—*P. hosei* GAGNEP. op. cit. 8 (1928) 621.**

Stem of unknown length (tops only collected), up to 1 cm thick, glabrescent or sparsely crispate-setulose above. Leaves obliquely elliptic or ovate or obovate, 8-20 by 5-10½ cm, cuneate-attenuate at base, apex rounded and shortly apiculate or narrowed and shortly acuminate, margin undulate-denticulate, glabrous above, almost glabrous below except for some short setulae on the midrib, sparsely setulose below when young, thin in texture; midrib sometimes rather broad towards base; main nerves 2-4 pairs; petiole 2-3 cm, glabrescent to rather densely and shortly crispate-setulose. Inflorescences borne singly in the uppermost 1-2 axils, capitate to scorpioid, 10-30-flowered, dense and compact, 2-4 cm long; peduncle 7-8 mm, setulose. Bracts membranous, the lower ones broadly elliptic-ovate, 10-13 by 7-10 mm, glabrous. Flowers 10-15 mm long. Calyx-tube ellipsoid, 7 by 3 mm, gradually narrowed below into the short pedicel (which elongates later). Sepals obovate, 4-7 by 2-3½ mm, rounded or retuse, erose-denticulate. Corolla 3-4 mm long, gamopetalous to about 1½-1½, fleshy; segments ovate, obtuse to subacute, recurved at apex. Filaments 1½-2 mm; anthers linear-oblong, 1½ mm, connivent round stigma. Style thick, 2 mm, narrowed upwards; stigma discoid-capitate, 5-lobulate, 1½ mm diam., 1 mm thick. Fruit ellipsoid-obovoid, 8 mm.

Distr. Malaysia: Borneo (Sarawak, Brunei, N. Borneo).

Ecol. Primary and secondary rain-forest on sandstone at 3-400 m; fl. & fr. Nov.-Dec., Feb.

Notes. There is little that is distinctive in the foliage of this species; but the inflorescence sometimes suggests a luxuriant, coarse edition of that of *P. horsfieldii*, the flowers being about double the size of the latter. The luxuriant condition, described by GAGNEPAIN as *Francfleuria hosei* (later transferred to *Pentaphragma*), is not specifically separable from *P. viride* STAPF & GREEN.

\* The combination was not validly published here, since the genus *Pentaphragma* was not described until 1834 (by G. DON, l.c.).



Fig. 2. *Pentaphragma begoniifolium* (ROXB. ex JACK) WALL. ex G. DON. a. Habit,  $\times 1/2$ , b. flower,  $\times 2$ , c. corolla, d. stamen, e. style (after JACK).—*P. grandiflorum* KURZ. f. Flower,  $\times 3/4$ , g. style,  $\times 3$ , h. stamen,  $\times 3$  (PULLE 406).—*P. aurantiacum* STAPF. i. Flower,  $\times 1 1/4$ , j. style,  $\times 1 1/2$  (CLEMENS 28999).



**18. *Pentaphragma horsfieldii* (MIQ.) AIRY SHAW,** Kew Bull. (1953) 249.—*Cyrtandra horsfieldii* MIQ. Fl. Ind. Bat. 2 (1857) 738.—*P. scortechinii* KING & GAMBLE, J. As. Soc. Beng. 74, 2 (1905) 55, incl. var. *parvifolia* and *flocculosa* K. & G.; RIDL. Fl. Mal. Pen. 2 (1923) 203; BURK. Dict. 2 (1935) 1691.—*P. sumatranum* RIDL. J. Fed. Mal. St. Mus. 8, 4 (1917) 56.—*P. integrifolium* MERR. Pap. Mich. Acad. Sc. 19 (1934) 202.—*P. integrifolium* var. *longipetiolata* MERR., l.c. 203.

Very variable. Stem 10–50 cm long, simple,  $\pm$  crispate-floccose above. Leaves only slightly asymmetrical, broadly ovate to obliquely elliptic-oblong, 10–30 by 4–12(–20) cm, base cordate to cuneate, apex acute to obtuse, margin strongly dentate-serrate to entire, frequently reflexed, glabrous and shining above,  $\pm$  crispate-floccose below (usually densely so when young), at least on the nerves, but sometimes almost glabrous; nerves 2–4 pairs, steeply ascending; petiole  $1\frac{1}{2}$ –8 cm,  $\pm$  crispate-floccose or glabrescent. Inflorescences arising singly or more often 2–3 together from the upper (1–5) leaf axils, dense, many-flowered, scorpioid, short or long, 1–7 cm, peduncle  $\pm$  1 cm. Bracts orbicular to obovate, 5–8 mm long, ciliate. Flowers biseriate, 5–8 mm long. Calyx-tube obovoid, 3–4 by 2 mm, pilose. Sepals unequal, scarcely 2 mm long, pilose, margins reflexed. Corolla very shortly (scarcely 1 mm) gamopetalous, 3 mm long, glabrous; segments oblong or spatulate-obovate, erect, recurved at apex. Filaments  $1\frac{1}{2}$  mm, slender, sometimes sigmoid; anthers oblong, 1 mm. Stigma ovoid-oblong, 1 mm. Fruit ovoid or obovoid, 5 by 3–4 mm.

Distr. *Malaysia*: Sumatra (incl. Batu Island), Riouw and Lingga Archip., Malay Peninsula, Banka, Anambas Islands, Borneo (Sarawak).

Ecol. Evergreen rain-forest, up to 1200 m; fl. Jan.–Dec.

Vern. *Kobeh*, *balong ayam batu*, Mal. Pen., *silam buwie*, Sumatra.

Uses. Leaves eaten as spinach (Kemaman, acc. to CORNER *in sched.*).

Notes. The true limits of this species are at present quite uncertain. On the assumption, however, that the complex of forms here placed under *P. × ellipticum* POULSEN represents a hybrid swarm from *P. acuminatum* A.S. and another species, one may postulate for 'pure' *P. horsfieldii* a plant, crispate-pubescent throughout, with large, broadly ovate, subentire, long-petioled leaves and dense, scorpioid, many-flowered inflorescences. A close approach to such a plant is in fact made by several specimens from the Malay Peninsula that have been currently referred to *P. scortechinii*, and I would propose therefore provisionally to regard these as being for practical purposes 'pure'. There is, however, no evident break between them and the presumed hybrids with *P. acuminatum*.

It is noteworthy that the only collection seen from Borneo that appears to be referable to this species (Sarawak: Mt Lambia, 29 May 1895, HAVILAND & HOSE 2027, in Herb. Mus. Brit.) is markedly heterogeneous. It consists of five 'snip-

pets', each bearing one or two leaves with (in four cases) their subtended inflorescences and very short lengths of stem. In three of the pieces the leaves are entire, and the inflorescences quite glabrous, while in the other two the leaves are sinuate-denticulate and the inflorescences densely crispate-pubescent. This may well be part of another hybrid swarm, such as is postulated for *P. × ellipticum* POULSEN.

The leaves of a gathering from Sumatra bore on their margins a growth of the moss *Distichophyllum cuspidatum* DOZY & MOLK. (det. VAN DER WUJ).

**18a. *Pentaphragma × ellipticum* POULSEN (*pro sp.*),** Vid. Medd. Nat. Foren. Kjöbenhavn 1903, 321 (1903), t. IV–V; MERR. Sarawak Mus. J. 3 (1928) 557, *in obs.*; *emend.* AIRY SHAW.—*P. ridleyi* KING & GAMBLE, J. As. Soc. Beng. 74, 2 (1905) 57; RIDL. Fl. Mal. Pen. 2 (1923) 204.—*P. acuminatum* AIRY SHAW  $\times$  *P. horsfieldii* (MIQ.) AIRY SHAW.

Heterogeneous populations showing various combinations of the characters of the putative parents.

Distr. *Malaysia*: Malay Peninsula, Lingga Archipelago, Banka.

Ecol. Evergreen rain-forest.

Vern. *Daun djari kretèh* (*kèrètah*), *sètabel* (Lingga).

Uses. BÜNNEMEIJER states (*in sched.*) that an infusion of leaves, and especially roots, is used for venereal disease, and leaves are laid on the stomach for constipation in small children, in Lingga. According to FURTADO the leaves are eaten as a vegetable in Perak.

Notes. It is difficult to account for the extraordinarily mixed populations apparently occurring in the southern part of the Malay Peninsula and in the Lingga Archipelago, except on the assumption of extensive hybridization between two or more species. The solution here suggested is purely tentative; it is evident that these populations can be adequately interpreted only in the field.

**19. *Pentaphragma acuminatum* AIRY SHAW,** Kew Bull. (1953) 248.

Stem 12–30 cm long, glabrous, or sometimes  $\pm$  furfuraceo-puberulous on the young parts. Leaves rather small, obliquely ovate to (more often) ovate-lanceolate, 8–15 by 3–5 cm, base decurrent-cuneate, more rarely  $\pm$  rounded, apex gradually attenuate-acuminate, margin very shortly obtusely undulate-dentate and often revolute, glabrous above or (especially on the nerves) sparsely and minutely puberulous or very minutely granulose-papillose, mostly thin in texture; nerves 2–3 pairs, little curved; petiole  $1\frac{1}{2}$ –2 cm, slender, glabrous or sparsely furfuraceo-puberulous. Inflorescences arising singly or in pairs from the 1–4 middle or upper (but not uppermost) leaf-axils, small, capitate, not scorpioid, c. 1 cm diam., 2–10-flowered, peduncle c. 5 mm, glabrous. Bracts glabrous, the lowest ovate-lanceolate, 7 by 3 mm, acute, the upper ones decreasing





Fig. 3. *Pentaphragma spatulisepalum* A.S. a. Habit,  $\times 2/5$ , b. flower,  $\times 2 1/2$  (J. C. MOULTON s.n., SING.).—*P. combretiflorum* A.S. c. Habit,  $\times 2/5$ , d. flower,  $\times 2$  (BÜNNEMEIJER 5821).

rapidly in size. Flowers c. 1 cm long. Calyx-tube 5–6 by 3–4 mm, glabrous. Sepals c. 3 by up to 2 mm, obtuse. Petals c. 3 by almost 2 mm, obtuse or slightly cucullate, reflexed. Stamens c.  $1 1/2$  mm long; anthers oblong. Style thick,  $1-1 1/2$  by 1 mm; stigma very thick,  $1.25$  by  $1.25$  mm. Fruit ellipsoid, 7–8 by 4–5 mm, glabrous.

Distr. Malaysia: Borneo; several times collected.

Ecol. Primary rain-forest up to 1500 m; fl. & fr. Aug.–Oct.

Notes. It is tentatively suggested that this species may represent one parent of the presumed hybrid swarm here referred to *P.  $\times$  ellipticum* POULSEN. Its almost completely glabrous condition, the gradually acuminate, shallowly sinuate-dentate leaves, and the small, few-flowered inflorescences, are characteristic.

## STYLIDIACEAE († D. F. Van Slooten, Amsterdam)

The family consists of 5 genera, if *Donatia* FORST., of which the systematic position is not at all certain, is included. Four genera are confined to Australia, Tasmania, New Zealand and the Magellan region of South America. *Stylidium* is almost entirely Australian, but a few *spp.* occur in *Malaysia*, Ceylon, and continental SE. Asia.

### 1. STYLIDIUM

SWARTZ *ex* WILLD. Sp. Pl. 4 (1805) 146; MILDBRAED, Pfl. R. Heft 35 (1908) 30; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 65; *ibid.* 14 (1937) 169, *nom. cons.*

Small, annual or perennial herbs, often with glandular hairs. *Leaves* small, alternate, cauline or radical-rosulate (or verticillate), simple, entire, exstipulate. *Inflorescences* terminal. *Flowers* ♂, zygomorphic, usually cymose or racemose. *Calyx* gamosepalous; segments 5, the 2 anterior ones often adnate into a bifid lobe. *Corolla* generally conspicuous, sympetalous, irregular, 5-merous, often with a paracorolla formed by coronal or gland-like appendages in the throat; segments free or 2 or 4 of them connate, the fifth developed as a labellum usually smaller than the other segments. Stamens 2, lateral, the filaments entirely adnate to the style into an elongate, usually exserted and geniculate column, which is sensitive and mobile at its base; anthers extrorse, sessile just below the stigma, 2-celled. *Ovary* inferior, 2-celled or partly 1-celled by an imperfect septum; ovules usually numerous. *Capsule* dehiscent; seeds very small.

*Distr.* About 120 *spp.*, all but 8 being confined to Australia. Of these 8, four are Asiatic and entirely extra-Australian, one species, *S. kunthii* WALL. *ex* DC., being known from India only. The fifth species, *S. schizanthum* F.v.M., occurs in N. Australia and in Papua. *S. alsinoides* R.BR. is found from Queensland to Celebes and the Philippines. *S. uliginosum* Sw. occupies a disjunct area, viz Queensland, Hong-kong, south coast of China, Hainan, and Ceylon. Probably it will be collected in the future in Peninsular India, Indo-China, and in Malaysia where it was not recorded so far. *S. pedunculatum* R.BR. occurs in N. Australia and the S. Moluccas.

*Ecol.* From sea-level up to 1100 m (or 1500 m: *S. graminifolium* Sw.), usually in uliginose, peaty, swampy, muddy or inundated and temporarily desiccated localities, near wells, along water-courses, and on rice-fields after the harvest, but also often on loamy or humous soils as well as on loose sand or on comparatively dry habitats, even on barren gravelly soil or on rocks; on flat open grass-lands as well as among open brushwood, sometimes in *Eucalyptus*-stands, in flat land or on hills. In Australia the main flowering season seems to be September to January.

*Notes.* Often graceful of habit, usually with brightly coloured flowers. Not cultivated.

#### KEY TO THE SPECIES

1. Stem thickish, up to 3 cm, bearing an apical, dense tuft of narrow-lanceolate, mucronate leaves  $\frac{1}{2}$ –1 cm long. Peduncles leafless, filiform, 1-flowered. Capsule 7–8 mm long. **6. *S. pedunculatum***
1. Leaves either cauline or in a basal rosette, not mucronate. Inflorescences at least 2-flowered.
2. All corolla segments free, the posterior one bifid. Appendages of the corolla-tube small but distinct.
3. Cauline leaves numerous, alternate in the lower, opposite in the upper part. Inflorescences lax, many-flowered. Flowers rosy. Corolla glabrous . . . . . **2. *S. inconspicuum***
3. Leaves subrosulate, stem few-leaved. Inflorescences composed of 2–3 flowers only. Flowers white. Corolla sparingly glandular hairy . . . . . **1. *S. tenellum***
2. Either the posterior corolla segments or the lateral ones connate with each other. Appendages of the corolla-tube distinct or absent.
4. Stem glandular-puberulous. Flowers yellow. Appendages distinct. Calyx laxly glandular hairy. Labellum inserted below the margin of the corolla-tube . . . . . **5. *S. schizanthum***
4. Stem glabrous. Flowers white or rosy-purplish. Appendages absent. Calyx glabrous. Labellum inserted at the margins of the corolla-tube.
5. Corolla white, 2–3 mm long. Column 2–3 mm long . . . . . **4. *S. alsinoides***
5. Corolla rosy-purplish, 4–4½ mm long. Column 5 mm long . . . . . **3. *S. javanicum***

1. *Stylidium tenellum* SWARTZ, Mag. Ges. Naturf. Fr. Berlin 1 (1807) 51, t. 2, f. 3; MILDBRAED, Pfl. R. Heft 35 (1908) 35; SLOOT. Bull. Jard. Bot. Btżg III, 6 (1924) 66; *ibid.* 14 (1937) 170, non R.Br. 1810.

Annual, erect, 5–20 cm high. Stem simple or very sparingly dichotomously branched, glabrous, with a few leaves only. *Leaves* scattered, (sub)sessile, (oblong-)obovate, blunt, the lower leaves somewhat rosulate and 10 mm long at the utmost, the upper ones smaller and gradually passing into the linear bracts. *Inflorescences* composed of 2–3 flowers or subdichotomously branched.



Fig. 1. *Stylidium inconspicuum* SLOOT.  
Habit, nat. size.

Flowers very small, sessile. *Calyx* thinly sprinkled with glandular hairs or glabrous; tube (ovary) very narrow, about 10 mm long; two of the segments connate into a slightly bifid lobe. *Corolla* very small, white (or violet?), very sparingly glandular hairy; tube hardly longer than the calyx lobes; appendages of the throat minute though distinct; segments free, the posterior ones bifid, the anterior segments much smaller; labellum very small, subulate. *Capsule* linear, up to 2 cm long.

Distr. Mergui, Indo-China, in *Malaysia*: N. Sumatra, Malay Peninsula. Not in Australia.

Ecol. Rare, found twice in Sumatra: once in Tapanuli in a swamp, 1100 m, and once in the Padang Uplands in rice-fields, 800 m.

Vern. *Sakkar ni sarampitpit*, Toba.

Notes. MILDBRAED stated that the corolla was white, though *S. roseum* KURZ is considered by him to be conspecific.

2. *Stylidium inconspicuum* SLOOT. Bull. Jard. Bot. Btżg III, 14 (1937) 171, f. 1–2.—Fig. 1–2.

Annual, erect, slender, 5–20 cm high. Stem slender, simple or in the upper part with erectopatent branchlets, glabrous, leafy. *Leaves* alternate along the stem, sessile, very thin, ovate, subacute, c. 7 mm long and 5 mm wide, the floral leaves opposite (every pair consisting of one leaf and one bract), attenuate. *Inflorescences* very lax, many-flowered. Flowers sessile in the axil of the leaf-like bracts. *Calyx* sparsely sprinkled with glandular hairs; tube very short; segments linear,

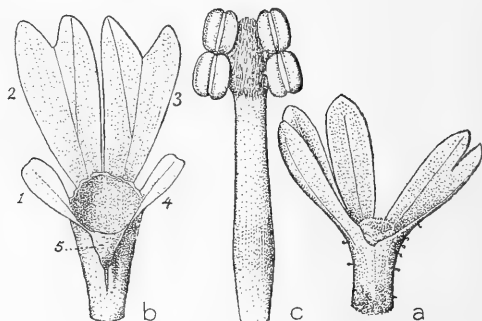


Fig. 2. *Stylidium inconspicuum* SLOOT. a. Calyx, b. corolla (2 & 3 posterior segments, 1 & 4 anterior segments, 5 labellum), c. column; all  $\times 12$ .

subacute, the 2 anterior ones connate into a bifid lobe. *Corolla* very small, rose-coloured, glabrous; tube about as long as the calyx-lobes; appendages of the throat hardly visible; segments free, the posterior ones bifid, subspathulate-oblong, up to 2 mm long, the anterior bifid equal, 1 mm long, subretuse, slightly notched at the top; labellum very small, subdeltoid, acuminate, without appendages. Column much exerted, geniculate, up to  $3\frac{1}{2}$  mm long. *Capsule* narrowly linear,  $1\frac{1}{2}$  cm long.

Distr. *Malaysia*: W. Central Java (Indramaju).

Ecol. In the forest-section Indramaju it grows

in periodically moist places of grass-fields at 20–30 m, under seasonal conditions, together with the next species; locally common. Unlike *S. tenellum* it seems to be a species of the lowlands.

**3. *Stylidium javanicum* SLOOT.** Bull. Jard. Bot. Btzg III, 14 (1937) 173, f. 3.—Fig. 3.

Annual, erect, slender, up to 20 cm high. Stem thin, in the upper part with erecto-patent branchlets, glabrous, leafy. *Leaves* alternate along the stem, sessile, ovate, subacute, 7–8 mm long, 4–5 mm wide, the floral leaves opposite (leaf and bract), attenuate. *Flowers* sessile in the axil of the leaf-like bracts. *Calyx* glabrous; tube very short; segments linear, acute, the 2 anterior ones connate into an oblong bifid lobe. *Corolla* rather large, rosy-purple, without or with a few glandular hairs; tube about half as long as the calyx lobes;

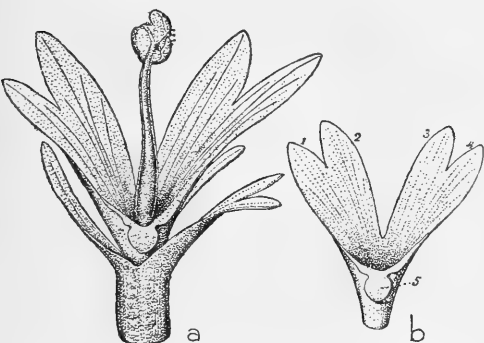


Fig. 3. *Stylidium javanicum* SLOOT. a. Flower on apical part of ovary,  $\times 8$ , b. corolla separately (1 & 2 and 3 & 4 connate pairs of each one anterior and one posterior segment, 5 labellum),  $\times 5$ .

appendages of the throat not seen; segments oblong, not free, 4–4½ mm long, attenuate or abruptly acuminate, 4 of the segments connate into 2 bifid lobes, separated by a deep incision; labellum minute, deltoid-ovoid, without appendages. Column much exerted, geniculate, c. 5 mm long. *Capsule* linear, glabrous, c. 1½ cm long.

Distr. *Malaysia*: W. Central Java (Indramaju), Lesser Sunda Islands (E. Sumba).

Ecol. Periodically wet grass-fields, under seasonal conditions, locally common, in Java at 20–30 m, in Sumba in a marsh at 500 m.

**4. *Stylidium alsinoides* R.BR.** Prod. (1810) 572; MILDBRAED, Pfl. R. Heft 35 (1908) 40; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 66; Nova Guinea 14 (1926) 195; Bull. Jard. Bot. Btzg III, 14 (1937) 172.

Annual, erect, in all parts glabrous and without glandular hairs, up to 35 cm high. Stem repeatedly branched from the base, 5-angular to 5-costate, whitish or green, turning carmine. *Leaves* variously coloured, alternate or distichous along the stem, sessile, broadly ovate, cuneate or subrounded at the base, 7–8 mm long and wide, the floral

leaves opposite (leaf and bract), broadly ovate or elliptic-lanceolate, subacutely attenuate, smaller than the cauline leaves. *Inflorescences* cymose, many-flowered. Flowers sessile in the axil of the leaf-like bracts. *Calyx*-tube (ovary) 12–13 mm long; segments linear, the 2 anterior ones connate into a slightly bifid lobe. *Corolla* small, white with a fine violet streak passing into white, tube about half as long as the calyx-lobes, appendages of the throat absent; segments 2–3 mm long, not free, 4 of which being connate into 2 bifid lobes separated by a deep incision; labellum sub-3-angular or suborbicular, without appendages. Column little exerted, 2–3 mm long. *Capsule* linear, 10–22 mm long.

Distr. N. Australia and Queensland, in *Malaysia*: S. New Guinea (vicinity of Merauke and near Wuroi), SW. & SE. Celebes, and the Philippines.

Ecol. In New Guinea it was found on a sandy ridge in the shadow of grass, and on damp savannah ridges, 0–30 m, growing luxuriantly, in Celebes on roadsides and rice-fields up to 950 m.

Note. The species was recorded for the Philippines by MERRILL (En. Philip. 3, 1923, 591) but I have not seen specimens from that area.

**5. *Stylidium schizanthum* F.v.M.** Fragm. 1 (1858) 152; BENTH. Fl. Austr. 4 (1869) 25; MILDBRAED, Pfl. R. Heft 35 (1908) 38.

Annual, erect, very slender, up to 35 cm high. Stem slender, leafless or with a single linear leaf, sparingly furnished with very short glandular hairs. *Leaves* petioled, subrosulate, obovate-subspathulate, usually 5 mm long or less; petioles half as long as the blades. *Inflorescences* large, very lax, cymose, many-flowered. Flowers (sub-)sessile; bracts minute, lanceolate. *Calyx*-tube and lobes very laxly glandular-hairy; tube (ovary) filiformous, 7–10 mm long; lobes oblanceolate-subspathulate, 2–2½ mm long, the 2 anterior ones somewhat larger and connate almost up to the very top. *Corolla* pale yellow (BRASS), 5 mm long, tube glabrous or very laxly glandular-hairy, about as long as the calyx-lobes; appendages of the throat 2, broad and distinct; between the anterior and posterior segments with a conspicuous glandular corpusculum; segments not free, the posterior ones 2–3 mm long, connate about half their lengths, bifid, forming together a 4-fid whole with unequal lobes, the anterior segments smaller, equal, dissected at the top, the lobes linear; labellum small, lanceolate-ovate, long-acuminate, inserted below the margin of the tube, without appendages. Column geniculate, 5–6 mm long. *Capsule* narrow, 1 cm long or less.

Distr. N. Australia, in *Malaysia*: SE. New Guinea (Fly River area).

Ecol. Once found on grey soil on a savannah ridge at 30 m, and once in dense turf on wet grasslands.

Notes. Closely related to *S. lobuliflorum* F.v.M., a herb of c. 12 cm height, with rose-coloured flowers and with a connective exceeding the anthers with a bifid apex. The BRASS-numbers from Papua (5796 and 7825) have the anterior calyx-lobes

almost entirely connate and not two-thirds their length.

6. *Stylidium pedunculatum* R.Br. Prod. (1810) 571; DC. Prod. 7 (1839) 337; BENTH. Fl. Austr. 4 (1869) 28; BAILEY, Queensl. Fl. (1900) 890; MILDBRAED, Pfl. R. Heft 35 (1908) 39; BAILEY, Compr. Cat. Q. Pl. (1912) 282, f. 249.—*Candollea pedunculata* F.v.M. Syst. Cens. (1882) 86; Sec. Syst. Cens. (1889) 145; BRITTEN, Ill. COOK's Voy. 2 (1901) 53, t. 170c (after type).—*St. bryoides* F.v.M. Fragm. 6 (1867) 91.—Fig. 4.

Glabrous, ?perennial. Stems single or 2 together,

c. 2–3 cm high, at the base with a few small leaves, at the top with a dense tuft of crowded leaves. *Blades* sessile, narrow-lanceolate, 5–10 by  $2\frac{1}{5}$ – $3\frac{1}{5}$  mm; midrib distinct, margins nerve-like thickened and rough by distinct papillae, apex mucronate by hyaline hair-like cells, mucro sometimes forked. Peduncles 3–8 from the tuft, 1-flowered, exceedingly thin-filiform, terete, c. 2–3 cm. *Flower* subtended by 2 tiny, narrow, acute bracts  $\frac{1}{2}$  mm long. Fruit obliquely patent, linear, terete, with 2 longitudinal ribs, 7–8 by  $\frac{1}{2}$  mm, splitting from the top downwards with 2 valves; dissepiment  $\frac{1}{8}$  mm broad.

Distr. N. Australia and N. Queensland, in Malaysia: South Moluccas (Aru Islands; P. Trangan, between Kp. Meroor and Kp. Selarin, BUWALDA 5534).

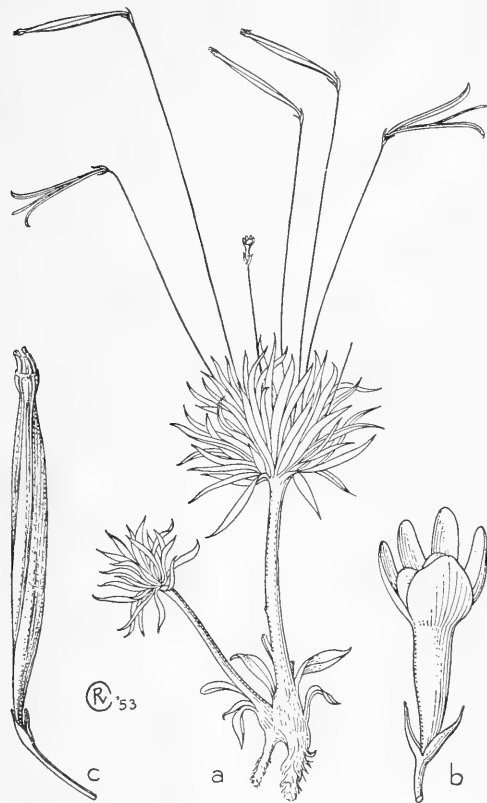


Fig. 4. *Stylidium pedunculatum* R.Br. a. Habit  $\times 2$ , b. flower without corolla,  $\times 18$ , c. fruit  $\times 6$  (After BUWALDA 5534).

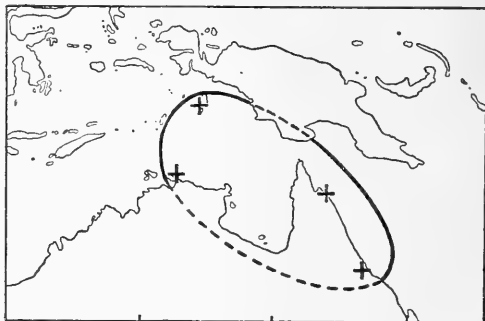


Fig. 5. Localities of *Stylidium pedunculatum* R.Br.

Ecol. Coastal sandy *Melaleuca* savannah, collected together with *Xyris oligantha*, *Restionaceae*, etc., fr. July 1938.

Note. The cited Malaysian material came at hand Sept. 1953 and I am responsible for the identification, description, and figure. This species is apparently rare (fig. 5). Mr J. H. KERN, who was so kind to compare the Malaysian material with the type sheets of BROWN and MUELLER in respectively the Brit. Museum and the Royal Botanic Gardens, Kew, could only locate the following specimens in these herbaria: *N. Australia*: Port Essington, ARMSTRONG 597 (K); *N. Queensland*: Endeavour River, BANKS & SOLANDER a. 1770 (BM, type of *S. pedunculatum* L.), CUNNINGHAM 103 (BM); Rockingham Bay, DALLACHY (K, type of *S. bryoides*).—VAN STEENIS.

## COMBRETACEAE (A. W. Exell, British Museum, London)

Trees, shrubs or lianas, rarely subherbaceous. Glands (in *Mal. spp.*) often present on the leaf-bases or petioles, and in lower marginal crenations. Indumentum of simple hairs, glandular hairs or multicellular hairs secreting calcium oxalate and forming scales, or present beneath the cuticle making the surface of the leaf minutely verruculose and sometimes pellucid-punctate. *Leaves* opposite, verticillate, spiral, or alternate, petioled (rarely sessile), exstipulate, simple, almost always entire. *Flowers* ♀ or ♂ and ♂ in the same inflorescences, usually protogynous, usually actinomorphic, rarely slightly zygomorphic, in axillary or extra-axillary elongated or subcapitate spikes or racemes or in terminal and sometimes axillary panicles. *Receptacle* (calyx-tube) usually in two distinct parts, the lower receptacle surrounding and adnate to the inferior ovary and the upper receptacle produced beyond to form a short or long tube terminating in the calyx-lobes, the latter sometimes poorly developed. *Calyx*-lobes 4 or 5 (rarely 6–8) or almost absent, sometimes accrescent (*Calycopteris*). *Petals* 4 or 5 or absent, conspicuous or sometimes very small, inserted near the mouth of the upper receptacle. *Stamens* usually twice as many as the petals, borne inside the upper receptacle usually in two series, exerted or included; anthers dorsifixed, usually versatile (or rarely adnate to the filaments). *Disk* intrastaminal, usually present, hairy or glabrous. *Style* usually free (attached for part of its length to the upper receptacle in *Quisqualis*). *Ovary* inferior (semi-inferior in the West-African genus *Strephonema*), unilocular, with usually 2 (sometimes 2–6) pendulous, anatropous ovules of which only 1 usually develops. *Fruit* (botanically a pseudocarp) very variable in size and shape, fleshy or dry, usually indehiscent, often variously winged or ridged, 1-seeded. Albumen absent.

Distr. 18 genera with c. 450 *spp.* in the tropics and subtropics: 2 are circumtropical (*Combretum* and *Terminalia*), and are much the largest genera, 1 is confined to North Australia and Queensland (*Macropteranthes*), 2 confined to tropical Asia (*Finetia* and *Calycopteris*), 3 occur in Asia and Africa (*Anogeissus*, *Lumnitzera*, and *Quisqualis*), 1 is confined to Madagascar (*Calopyxis*), 3 are confined to tropical Africa (*Guiera*, *Pteleopsis* and *Strephonema*), 2 occur in tropical Africa and tropical America (*Conocarpus* and *Laguncularia*) and the remaining four (*Buchenavia*, *Bucida*, *Ramatuella* and *Thiloa*) are confined to tropical and subtropical America.

Ecol. Species of *Terminalia* are important constituents of both primary and secondary forests, more especially in the lower regions, only a few species reaching an altitude of about 2000 m. *Combretum* species are common lianas especially along banks of rivers and margins of forests. Two species of *Lumnitzera* play an important rôle in the mangrove-formation (a formation to which the genera *Lumnitzera* and *Laguncularia* are both confined). *Terminalia catappa* is a common constituent of the littoral forest, on the sandy beach-ridge or on rocky shores along eroding coasts. Most species are insect-pollinated.

According to RIDLEY (Disp. 102, 210) dispersal of the fruits is frequently through water agency, either sea-water (*Lumnitzera*, *Terminalia catappa*) or freshwater of streams and rivers (flat-fruited and drupaceous-fruited *Terminalia spp.* and *Combretum spp.* with narrow-winged or angled type of fruit). *Quisqualis* fruits are buoyant in both fresh and sea-water. In many other species of *Combretum* and *Terminalia* the fruits are provided with thin, papery wings and are dispersed by wind; their size probably prevents them from reaching great distances.

Wood anat. DEN BERGER, Determinatietabel van Malesië, Veenman, Wageningen (1949) on several pages (handlens); DESCH, Man. Malayan Timb., Mal. For. Rec. 15 (1941) 83; METCALFE & CHALK, Anat. Dic. 1 (1950) 617; MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 359; PANSIN, Philip. J. Sc. 48 (1932) 182; PEARSON & BROWN, Comm. Timb. 1 (1932) 496; REYES, Commonwealth Philip. Dept Agric. Techn. Bull. 7 (1938) 364. For details see under species.

For review of research on mangrove anatomy and water relations see: Fl. Mal. I, 4 (1953) 513, for growth ring development in connection with bud burst (*Terminalia catappa* L.): COSTER, Ann. Buitenzorg 37 (1927) 116. JANSSONIUS (Blumea 6, 1950, 407) points out that the family has many features in common with other families and suggests that its wood structure indicates affinity especially with the *Leguminosae* and *Sapindaceae* and bears some relation to *Meliaceae*.—C.A.R.—G.

Uses. Some *Terminalia* species produce fairly good timber but in general the wood is rather soft and inferior. The fruits of this genus are often edible. A few species are planted as ornamental trees and some *Combretum* species are grown as stove plants in temperate countries. *Quisqualis indica* is often planted in gardens as an ornamental climber and a decoction of its fruits has been used as a vermicide. The wood of *Lumnitzera* spp. is sometimes used for fencing and local building purposes.

Notes. The family is related to the *Rhizophoraceae* and to the *Myrtaceae*. It was founded by R. BROWN (Prod. 1, 1810, 351) and delimited much as at present. HOOKER f. (in BENTH. & HOOK. f. Gen. Pl. 1, 1867, 683) profoundly modified this conception of the family by including the genera *Iligera*, *Gyrocarpus* and *Sparattanthelium*, plants with quite a different facies which are now placed in the *Hernandiaceae*. For an account of the relationships between the genera of *Combretaceae* see EXELL (J. Bot. 69, 1931, 113).

Three main evolutionary tendencies are observable in the family or can at least be reasonably postulated:

- 1) A gradual elongation of the upper receptacle, especially in *Combretum*, and reaching its highest development in *Quisqualis*, making pollination only possible by long-tongued insects.
- 2) A congestion of the flowers in densely-flowered spikes or racemes accompanied often by reduction in the size of the petals.
- 3) Distribution by means of winged fruits (though riverine species often have water-borne fruits and many species of *Terminalia* have edible fruits presumably dispersed by animals).

These three tendencies seem to have been to some extent independent of each other and the combination of 2 and 3 provides a spatial problem, that of allowing for the expansion of the wings of the fruit in a congested inflorescence. This problem has received various solutions in the family such as reduction of the wings to two or three (*Terminalia* spp.), interspersal of ♂ and ♀ flowers (*Pteleopsis* and *Terminalia*), the fitting together of the fruits into a cone-like structure (*Conocarpus*) etc..

For a general account of the anatomy and pharmacology of the *Combretaceae* see HOLTERMANN, 'Beiträge zur Anatomie der Combretaceen' (Christiania, 1893) and LEFÈVRE, 'Contribution à l'étude anatomique et pharmacologique des Combretacées' (Lons-Le-Saunier, 1905).

The main precursors of this revision were written by the late D. F. VAN SLOOTEN in his 'Bijdragen tot de kennis der Combretaceae and Flacourtiaceae van Nederlandsch Indië' (Utrecht, 1919)—henceforth cited as Bijdr. Combr.—and in Bull. Jard. Bot. Buitenzorg III, 6 (1924), both dealing only with the species occurring in Indonesia. I am deeply indebted to him for putting his manuscript notes at my disposal.

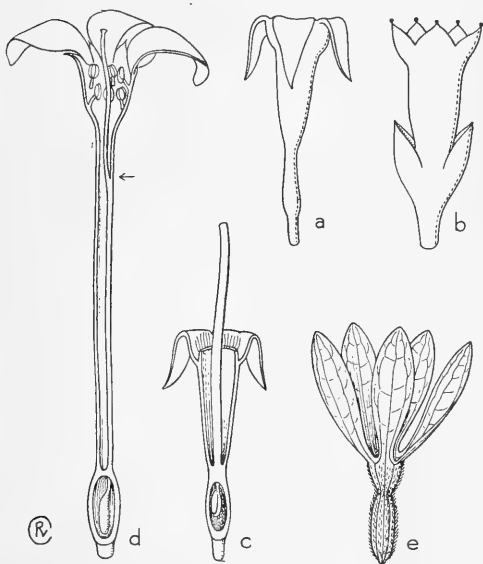


Fig. 1. Diagrams to illustrate the key to the genera. —a. Receptacle with calyx-lobes in *Combretum latifolium*, b. receptacle with calyx-lobes and 2 adnate bracteoles in *Lumnitzera racemosa*, c. vertical section of receptacle in *Combretum latifolium* showing inferior ovary, free style and upper (hairy) free part of disk inserted at apex of lower portion of upper receptacle, d. vertical section of flower of *Quisqualis indica* showing adnation of style to upper receptacle, e. fruit of *Calycopteris floribunda* showing accrescent calyx-lobes.

#### KEY TO THE GENERA

1. Receptacle without adnate bracteoles (fig. 1a). Leaves opposite, verticillate, or alternate.
  2. Petals present (in Malaysian species).
    3. Style not adnate to the inner wall of the upper receptacle (fig. 1c). Leaves often scaly. **1. Combretum**
    3. Style adnate for part of its length to the inner wall of the upper receptacle (fig. 1d). **2. Quisqualis**
  2. Petals absent. Leaves not conspicuously scaly.
    4. Calyx-lobes not accrescent . . . . . **3. Terminalia**
    4. Calyx-lobes very conspicuous, accrescent, persistent at time of fruiting (fig. 1e). **4. Calycopteris**
1. Receptacle with two adnate bracteoles (fig. 1b). Leaves alternate. Petals present. Trees of the mangrove formation . . . . . **5. Lumnitzera**

## 1. COMBRETUM

LOEFL. Iter Hispan. App. (1758) 308, *nom. cons.*<sup>1</sup>; SLOOT. Bijdr. Combr. (1919) 31; Bull. Jard. Bot. Btzig III, 6 (1924) 50.—*Grislea* LINNÉ, Sp. Pl. 1 (1753) 348.—*Cacoucia* AUBL. Pl. Guian. 1 (1775) 450, t. 179.—*Poivreia* COMM. [ex JUSS. Gen. Pl. (1789) 320 in *syn.*, *sphalm.* 'Pevraea'] ex THOU. Obs. Pl. Iles Austr. Afr. (1801) 28.—*Embryogonia* BL. Mus. Lugd. Bat. 2 (1852) 122.

Trees, shrubs or (probably always in Malaysia) woody climbers, very rarely sub-herbaceous. *Leaves* opposite, verticillate or rarely alternate, usually petiolate, almost always entire, glabrous or hairy, often conspicuously scaly and often with domatia. Petiole sometimes persisting after the fall of the leaf forming a thorn. *Flowers* usually ♀, actinomorphic or more rarely somewhat zygomorphic, 5- or 4-merous, in elongated or subcapitate, axillary or extra-axillary spikes or racemes or in terminal or terminal and axillary often leafy panicles, glabrous or hairy, often scaly. *Receptacle* (calyx-tube) glabrous or hairy, often scaly, sometimes glandular usually clearly divided into a lower part (lower receptacle) surrounding and adnate to the ovary, and an upper part, varying from patelliform to elongate infundibuliform, terminating in the calyx-lobes. Upper receptacle sometimes visibly differentiated into a lower part containing the disk and an often more expanded upper part. *Calyx*-lobes usually 4 or 5 (rarely more), deltoid to almost subulate or filiform, sometimes scarcely developed. *Petals* usually 4 or 5 (very rarely absent and never in Malaysian species), small and inconspicuous or showy and exceeding the calyx-lobes, white, yellow, orange, red or purple, glabrous or hairy, occasionally scaly. Stamens usually twice as many as the petals, inserted inside the upper receptacle, often in two series, usually exerted. Anthers dorsifixed, versatile. Disk intra-staminal, glabrous or hairy, with or without a free margin, sometimes absent or very small. Style simple, free, usually exerted, rarely very short. Ovary completely inferior, unilocular with usually 2 (occasionally up to 6) pendulous ovules. *Fruit* (pseudocarp) 4-5-winged, ridged or angled, sessile or stipitate, usually indehiscent, 1-seeded; pericarp usually thin and papery, sometimes leathery, more rarely fleshy.

Distr. About 250 *ssp.* throughout the tropics (except Australia), most abundant in tropical Africa, extending in the New World from Mexico to N. Argentina, in Africa from the Sudan to SW. Africa and Natal, across Arabia to northern India and thence E to S. China and S to Ceylon and New Guinea.

The Malaysian species belong to the following sections:

*sect. Kaloëdron* MIQ. (*C. trifoliatum*)

*sect. Glandulosae* ENGL. & DIELS (*C. nigrescens*)

*sect. Acuminatae* ENGL. & DIELS (*C. acuminatum*)

*sect. Dasystachyae* ENGL. & DIELS (*C. porterianum* and *C. yunnanense*)

*sect. Squamosae* ENGL. & DIELS (*C. punctatum*)

*sect. Tetragonocarpus* CLARKE (*C. tetralophum*)

*sect. Quisqualoides* CLARKE (*C. latifolium* and *C. sundaicum*)

*C. borneense* (fruits unknown) and *C. tetralophoides* (fruit winged, not angled) seem to be related to *C. tetralophum* and *C. goldieanum* probably belongs to *Sect. Trichopetalae* ENGL. & DIELS.

Ecol. The Malaysian species are mainly woody climbers of low-lying frequently flooded forests mostly between sea-level and about 100 m, but *C. sundaicum* has been found up to 250 m, *C. latifolium* up to 1000 m, and *C. punctatum ssp. punctatum* up to 1300 m. They frequently occur along river-banks, on the margins of primary forests and in secondary forest.

The narrow-winged or angled type of fruit in this genus seems associated with riverine habitats and

(1) The name is conserved as *Combretum* L. in LOEFL. but there is no general agreement as to which names in LOEFLING's 'Iter Hispanicum' ought to be attributed to LINNAEUS. The type species in the International Code of Botanical Nomenclature (1952) 122 is wrongly cited as *Combretum fruticosum* (LOEFL.) FAWC. & RENDLE. It should be *C. fruticosum* (LOEFL.) STUNTZ.



is correlated with dispersal by water as reported by RIDLEY (Disp. 102, 210) for *C. trifoliatum* and *C. tetralophum*, which he characterizes as riparian climbers.

Uses. *Combretum* spp. are of no economic importance in Malaysia but some introduced species are grown in gardens as ornamental climbers of which the most beautiful one is *C. grandiflorum* Don.

Notes. The flowers shrink appreciably on drying and measurements in the descriptions have been taken as far as possible from boiled up specimens. Species of *Malpighiaceae* often mistaken, when in fruit, for species of *Combretum* can be distinguished by the superior ovary and bifid hairs. Wingless fruits of *Combretum* can be distinguished from those of *Terminalia* by the absence of a sclerenchymatous layer in the pericarp so that they are easily cut across while those of *Terminalia* are usually somewhat or very resistant. Fruits of *C. trifoliatum* are sometimes mistaken for those of *Quisqualis indica*.

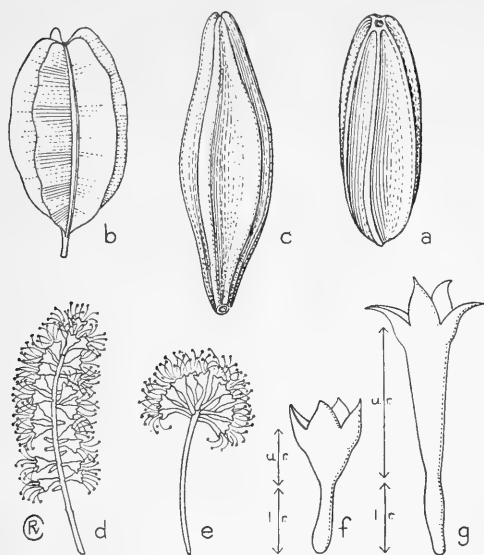


Fig. 2. Diagrams to illustrate the key to the *Combretum* species.—a. Fruit of *C. trifoliatum* with 5 narrow wings, b. fruit of *C. goldieanum* with 5 broad wings, c. fruit of *C. acuminatum* with 4 narrow wings, d-e. spikes of *C. punctatum* ssp. *squamosum* and ssp. *punctatum*, f-g. shape of upper receptacle (u.r.) and lower receptacle (l.r.) in *C. tetralophum* and *C. sundaicum*.

#### KEY TO THE SPECIES

1. Flowers 5-merous. Fruit narrowly or broadly 5-winged.
  2. Leaves usually 3-4(-5)-verticillate. Upper receptacle shallow-cupuliform, less than 1 mm long. Wings of fruit narrow, stiff, 3 mm broad (fig. 2a) . . . . . **1. *C. trifoliatum***
  2. Leaves opposite. Upper receptacle elongate-infundibuliform, 6-7 mm long. Wings of fruit thin, flexible, 6-7 mm broad (fig. 2b) . . . . . **2. *C. goldieanum***
1. Flowers 4-merous. Fruit narrowly or broadly 4-winged.
  3. Branchlets and inflorescences with dense or rather sparse papillose or shortly stalked glandular hairs (in addition to a pilose indumentum) . . . . . **3. *C. nigrescens***
  3. Branchlets and inflorescences not glandular but sometimes scaly.
    4. Calyx-lobes deltoid or broadly ovate, sometimes scarcely developed, not more than 1 mm long (in dried specimens).
      5. Fruit narrowly 4-winged or 4-ridged (fig. 2c).
        6. Rhachis nearly glabrous. Upper receptacle campanulate. Petals very small. Fruit  $3\frac{1}{2}$ -6 $\frac{1}{2}$  cm long. . . . . **4. *C. acuminatum***
        6. Rhachis ferrugineous-pubescent. (Fruit unknown.) . . . . . **8. *C. borneense***
      5. Fruit broadly 4-winged with thin, flexible wings.
        7. Leaves densely covered with greyish-white scales nearly contiguous on the lower surface of the leaf.
          8. Flowers in elongated spikes (fig. 2d). Leaves usually broadly elliptic.
            5. *C. punctatum* subsp. *squamosum*
            5. *C. punctatum* subsp. *punctatum*
          8. Flowers in subcapitate spikes (fig. 2e). Leaves usually lanceolate or narrowly elliptic.
            6. *C. portierianum*
  7. Leaves only sparsely scaly, scales never contiguous.
    9. Flowers 2-4 mm long from the rhachis to the tips of the calyx-lobes. Lower receptacle not more than 1 mm long (in dried specimens) . . . . . **6. *C. portierianum***
    9. Flowers 4-8 mm long from the rhachis to the tips of the calyx-lobes. Lower receptacle  $1\frac{1}{2}$  mm long or longer.
      10. Leaves nearly glabrous or pubescent only on the nerves beneath.
        11. Leaves with individually conspicuous golden-brown or reddish-brown scales on the lower surface . . . . . **7. *C. yunnanense***
        11. Leaves without individually conspicuous scales, coriaceous. Inflorescences ferrugineous-pubescent or tomentellous. (Fruit unknown.) . . . . . **8. *C. borneense***
      10. Leaves densely pubescent or tomentellous on the lower surface . . . . . **9. *C. tetralophoides***

4. Calyx-lobes triangular to elongate-triangular, at least  $1\frac{1}{2}$  mm long, usually 2 mm long or longer. Flowers 7–10 mm long from the rhachis to the tips of the calyx-lobes.
12. Tubular basal portion of the upper receptacle only about  $1\frac{1}{2}$  times as long as broad (fig. 2f) and separated from the lower receptacle (ovary) by a somewhat constricted portion. Petals usually equalling or exceeding the calyx-lobes. Fruit with 4 narrow, stiff wings or ridges.
10. **C. tetralophum**
12. Tubular basal portion of the upper receptacle 2–3 times as long as broad (fig. 2g) or whole upper receptacle narrowly infundibuliform. Petals shorter than the calyx-lobes. Fruit broadly 4-winged.
13. Spikes more or less elongated. Upper and lower receptacle and rhachis of inflorescence with a finely velutinous indumentum concealing any scales.
11. **C. latifolium**
13. Spikes capituliform. Upper and lower receptacle and rhachis scaly, otherwise nearly glabrous.
12. **C. sundaicum**
- 13a. Intermediates (from Luzon) between the two preceding species (?*latifolium*  $\times$  *sundaicum*).
- 12a. **C. confusum**

**1. Combretum trifoliatum** VENT. Choix Pl. (1808) t. 58; DON, Trans. Linn. Soc. Lond. 15 (1827) 419, 439; MIQ. Fl. Ind. Bat. 1, 1 (1855) 610; Suppl. (1860) 328; KURZ, For. Fl. Burm. 1 (1877) 461; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 454; K. SCHUM. & HOLLR. Fl. Kais. Wilh. Land (1889) 84; KING, J. As. Soc. Beng. 66, 2 (1897) 336; RIDL. J. Str. Med. Assoc. 5 (1897) 130 (*trifoliatum*); BACKER, Schoolfl. Java (1911) 492; KOORD. Exk. Fl. 2 (1912) 670; SLOOT. Bijdr. Combr. (1919) 40; Bull. Jard. Bot. Btzg III, 6 (1924) 51; GAGNEP. Fl. Gén. Indo-Chine 2 (1920) 743; MERR. En. Born. (1921) 423; DIELS, Bot. Jahrb. 57 (1922) 427; RIDL. Fl. Mal. Pen. 1 (1922) 708; CRAIB, Fl. Siam. En. 1 (1931) 621; Burkill, Dict. 1 (1935) 645; MEEUSE in BACK. Fl. Jav. (em. ed.) 4, fam. 101 (1944) 2.—*C. lucidum* BL. Bijdr. Fl. Ned. Ind. (1825) 641.—*Cacoucia? trifoliata* DC. Prod. 3 (1828) 22.—*Cacoucia lucida* HASSK. Cat. Hort. Bog. (1844) 254; Flora 27, 2 (1844) 607.—*Embryogonia lucida* BL. in Mus. Bot. Lugd.-Bat. 2 (1855) 122, t. 52 (1856).—**Fig. 2a.**

Climbing or scrambling shrub, 2–5 m. Young branchlets appressed fulvous-pubescent, soon glabrescent. *Leaves* usually 3–4 (5)-verticillate, coriaceous or subcoriaceous, elliptic to lanceolate, usually subglabrous above, glabrous below except for domatia and an occasional line of fulvous pubescence along the midrib, 8–16 by 3–5½ cm, normally acute and mucronulate at the apex (rarely rounded), usually slightly rounded at the base, nerves 6–8 pairs; petiole ferrugineous appressed-pubescent, eventually glabrescent, nigrescent and rather shiny when old, 4–7 mm long. *Inflorescence* a terminal or axillary panicle 8–20 cm long of spikes 2–5 cm long. *Flowers* 5-merous white or yellowish-white, sweet-scented, protogynous, mostly in whorls of 3. *Lower receptacle* (ovary) densely cinereous- or fulvous-sericeous,  $1\frac{1}{2}$  mm long; upper receptacle shallow-cupuliform, cinereous- or fulvous-sericeous,  $\frac{4}{5}$ –1 mm deep and 3–3½ mm across, with 5 ovate-triangular calyx-lobes 1 by  $1\frac{1}{3}$  mm. *Petals* 5, narrowly elliptic, densely pubescent, 1–1.4 by 0.2–0.4 mm. *Stamens* 10, filaments 4–5 mm long, anthers  $\frac{1}{2}$  mm long, exerted. *Disk* glabrous inside with densely barbate margin. *Style* 5 mm long. *Fruit* sessile, narrowly ellipsoid, glabrous, shiny black-brown,

(2½–)3–3½ by 1–1.2 cm with (4–)5(–6) rigid wings 3–4 mm broad.

Distr. Burma, Siam, Laos, Cambodia, Cochinchina, throughout *Malaysia*: not yet recorded from the Philippines, Moluccas, and the Lesser Sunda Islands (except Bali), in Java only along the north coast. **Fig. 3.**

Ecol. In lowlying frequently flooded areas, along banks of rivers and lakes, in bush or forest, borders of teak-forest, on limestone (Celebes) or alluvial river-clay both under everwet and seasonal conditions; fruit dispersed by water; *fl.* May–Nov.

Uses. RIDLEY (cf. BURKILL, Dict. 645) records the fruits as a vermifuge for *Ascaris* and GRESHOFF demonstrated a saponin in them (Kew Bull. 1909, 406). EDELING recorded the fruits as edible near Djakarta but this may be incorrect.

Vern. *Kubaing*, Djambi, *sěpang*, *akar nangkei*, Palembang, *akar song song harus*, M, *palawan*, Bantam, *kaju pělawad*, Bidara tjina, *areuj ki tjalong*, S, *gangang*, *tjéklok*, J, *tew*, New Guinea.

Notes. Collectors mostly give this species as a scrambling shrub but it has occasionally (perhaps incorrectly?) been described as a small tree and RIDLEY (*l.c.*) says it is a 'big climber'.

**2. Combretum goldieanum** F.v.M. Descr. Not. Pap. Pl. 4 (1876) 66; WHITE, Proc. R. Soc. Queensl. 34 (1922) 47; BAK. f. J. Bot. 61 (1923) Suppl. 13; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 51.—**Fig. 2b.**

Scandent shrub. Young branchlets cinereous, glabrescent. *Leaves* opposite, petioled, oblong-elliptic, acuminate at the apex, rounded at the base, minutely punctulate above, densely lepidote



**Fig. 3.** Localities of *Combretum trifoliatum* VENT. in *Malaysia*.

below but individual scales not conspicuous, 7–15 by 4–10 cm, sericeous when young, eventually glabrescent except for domatia. *Spikes* axillary, 6–8 cm long, occasionally branched. *Flowers* 5-merous, red, sessile. *Lower receptacle* (ovary) densely sericeous, 3–4 mm long; upper receptacle elongate-infundibuliform, appressed-pubescent, 8–9 mm long with 5 broadly deltoid calyx-lobes which are no more than blunt teeth at the apex of the tube. *Petals* 5, obovate-elliptic to oblong-lanceolate, 2½ by 1½ mm, pubescent outside, glabrous inside. Stamens 10; filaments dark red, exserted for 13–14 mm beyond the mouth of the tube, 5 attached at the margin of the disk and 5, alternating with the former, attached 3 mm from the base of the upper receptacle; anthers red, oblong, 1.2 by 0.8 mm. Disk cupular, c. 1 mm deep, barbate on the margin. Style 23 mm long, exserted for 14 mm beyond the mouth of the tube. *Fruit* broadly elliptic to suborbicular in outline, up to 2½ by 2 cm with 5 thin, flexible wings up to 8 mm broad.

*Distr. Malaysia:* SE. New Guinea (Port Moresby, Rigo Distr., Kappa Kappa, and Yule Island).

*Ecol.* Little known. Fide WHITE (*l.c.*) 'this rambling scandent shrub is very common about Port Moresby and with its brilliant red flowers is quite a conspicuous feature in the vegetation'. The elongation of the upper receptacle makes it only suitable for pollination by fairly long-tongued insects; the fruits are of the broadly winged wind-distributed type.

*Note.* Both F. VON MUELLER and VAN SLOOTEN have rightly pointed out the resemblance between this species and various African species of *Combretum* but it has not been identified with any African or Madagascar species so that its claim to be indigenous in New Guinea can scarcely be denied. I would myself relate it to the Indian species *C. pilosum* ROXB. (*sect. Trichopetalae* ENGL. & DIELS, mainly African).

Specimens from Port Moresby collected by FORBES and GOLDIE possess larger flowers and fruits than specimens collected by BRASS and LISTER TURNER from Rigo District and Kappa Kappa respectively; but the difference does not seem to be greater than that commonly met with in the species of this genus when enough material is available to show the range of variation.

**3. *Combretum nigrescens* KING, J. As. Soc. Beng.** 66, 2 (1897) 340; RIDL. Fl. Mal. Pen. 1 (1922) 710.—*C. kunstleri* KING, *l.c.*; CRAIB, Fl. Siam. En. 1 (1931) 617.—*C. scortechinii* KING, *op. cit.* (1897) 341.—*C. glandulosum* SLOOT. Bijdr. Combr. (1919) 39, t. 1, f. A; non *C. glandulosum* F. HOFFM. (1889).—*C. nigrescens* var. *kunstleri* RIDL. Fl. Mal. Pen. 1 (1922) 710.—*C. adenophorum* SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 56.—*C. elmeri* MERR. Pl. Elm. Born. (1929) 241.

Large climber up to 10–20 m. Young branchlets with a fulvous-patent-pilose (rarely appressed pilose) indumentum interspersed with glandular hairs, sometimes with the long patent hairs very

few and the glandular hairs much denser. *Leaves* opposite, papyraceous, narrowly elliptic or narrowly oblong-elliptic, sparsely pilosulose above or nearly glabrous except for appressed hairs towards the base of the midrib, rather sparsely appressed-pilose or nearly glabrous below, up to 13 by 4½ cm, acuminate at the apex, cordate (rarely cuneate) at the base; nerves 6–10 pairs; petiole patent-pilose often glabrescent, 2–8 mm long. *Inflorescence* a terminal or axillary panicle, 10–15 cm long, ultimate branches slender. *Flowers* white or greenish-white, 4-merous, sessile. *Lower receptacle* (ovary) pubescent or pilose, 1 mm long; upper receptacle cupuliform, viscid, puberulous, 1½ by 3 mm with triangular, acute calyx-lobes, ¾ by 1 mm. *Petals* 4, elliptic, pubescent, 1½ by 0.8 mm. Stamens 8, exserted; filaments 3–3½ mm long; anthers ¾ mm long. Disk small, densely pilose. Style 3½–4 mm long. *Fruit* 1½–3½ by 1.3–2 cm, glandular or glabrous, oblong-elliptic in outline with 4 membranous wings 4–6 mm broad and with the withered flower sometimes remaining attached to the apex of the fruit until the latter is mature or nearly so.

*Distr. Siam, in Malaysia:* SW. Sumatra, Malay Peninsula, Br. N. Borneo.

*Ecol.* In dense or open jungle from sea-level to 150 m.

*Uses.* The leaves are used in Pahang for poulticing wounds.

*Vern. Gégambir, pënon, pokok tulang dayong, Mal. Pen.*

*Note.* The amount of indumentum is very variable some specimens having densely pilose branches and inflorescences while others are very glandular with sparse long hairs.

*C. adenophorum* SLOOT., known only from one collection (FORBES 3100, SW. Sumatra), differs only in having cuneate leaf-bases. Further collecting is likely to provide intermediates.

**4. *Combretum acuminatum* ROXB. [Hort. Beng. (1814) 28 *nom. nud.*; ex DON, Trans. Linn. Soc. Lond. 15 (1827) 440 *nom. nud.*] Fl. Ind. ed. CAREY 2 (1832) 228; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 455; BAK. f. in ANDREWS, Mon. Christm. Isl. (1900) 178; RIDL. J. Str. Br. R. As. Soc. 45 (1905) 191; MERR. Philip. J. Sc. C. Bot. 4 (1909) 648; KOORD. Exk. Fl. 2 (1912) 620; SLOOT. Bijdr. Combr. (1919) 33; GAGNEP. Fl. Gén. I.-C. 2 (1920) 745; MERR. En. Born. (1921) 422; RIDL. Fl. Mal. Pen. 1 (1922) 708; MERR. En. Philip. 3 (1923) 148; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 57; BURKILL, Dict. 1 (1935) 644; MEEUSE in BACK. Fl. Jav. (em. ed.) 4, fam. 101 (1944) 4.—*C. costatum* ROXB. [Hort. Beng. (1814) 28 *nom. nud.*] Fl. Ind. 2 (1832) 227; KURZ, For. Fl. Burm. 1 (1877) 465.—*Embryogonia latifolia* BL. Mus. Bot. Lugd. Bat. 2 (1852) 122.—*Embryogonia acuminata* BL. *l.c.* (1852) 123.—*C. wallichii* (non DC.) HASSK. Tijds. Nat. Gesch. 10 (1843) 145; Flora 27 (1844) 606; MIQ. Fl. Ind. Bat. 1 (1855) 608.—*C. neuophyllum* MIQ. *l.c.*—*C. stenopetalum* HEURCK & MÜLL. ARG. in HEURCK, Obs. Bot. (1870) 225.—*C. vanheurckii* MÜLL. ARG. *op. cit.* (1870)**

227.—*Terminalia borneensis* RIDL. Kew Bull. (1938) 283, non *T. borneensis* SLOOT.—Fig. 2c.

Scandent shrub. Young branchlets densely ferrugineous-scaly and sometimes at first minutely puberulous, soon becoming glabrous. *Leaves* opposite, chartaceous or subcoriaceous, elliptic, oblong-elliptic, broadly lanceolate or sometimes oblanceolate, densely scaly but individual scales contiguous and not very conspicuous, nearly glabrous except for occasional hairs on the veins of the lower surface, 10–21 by 4–11 cm, usually acuminate at the apex with acumens up to  $1\frac{1}{2}$  cm long, cuneate, obtuse or rounded at the base; petiole scaly when young, 5–12 mm. *Inflorescence* of unbranched axillary spikes up to 10 cm long or occasionally of terminal panicles of spikes, ferrugineous-scaly and pubescent or nearly glabrous. Bracts very small, soon deciduous. *Flowers* yellowish, 4-merous, sessile. *Lower receptacle* (ovary) densely scaly, otherwise glabrous, 1– $1\frac{1}{2}$  mm long. Upper receptacle campanulate, scaly, outside glabrous, 2–3 mm long, inside pubescent, terminating in 4 deltoid calyx-lobes about 1 mm long. *Petals* 4, yellow, narrowly elliptic, very small, often less than  $\frac{1}{2}$  mm long, occasionally up to  $1\frac{1}{2}$  mm long. Stamens 8, exserted, 5–7 mm long. Disk cupular, about 0.8 mm deep, glabrous, hairy on the margin. Style  $5\frac{1}{2}$  mm long. *Fruit* densely scaly, especially when young, tomentellous or puberulous, eventually glabrescent,  $3\frac{1}{2}$ –6 $\frac{1}{2}$  by 1–2 cm, usually slightly narrowed at each end with 4 (rarely 5) longitudinal, rounded (occasionally sharp) ridges.

Distr. India, Ceylon, Burma, Indo-China and in *Malaysia*: Malay Peninsula, W. Java (incl. Christmas Isl.), Borneo, Philippines, SW. Celebes, Moluccas and northern New Guinea.

Ecol. Along the coast in low-lying frequently flooded areas, along rivers and in secondary forests at low altitudes.

Uses. A decoction of the leaves is used medicinally for tape-worm.

Vern. *Areuj balingbing*, *areuj tukul takal minjak*, *S. kalenleng didi*, SW. Celebes.

Note. Fruits probably water-borne (see note under *C. trifoliatum*).

FORBES 3250, from Sumatra, identified by E. G. BAKER as this species (J. Bot. 52, Suppl., 1924, 35), is *Lophopetalum oblongifolium* KING.

##### 5. *Combretum punctatum* BL. Bijdr. (1825) 640.

Climbing shrub or liana. Young branchlets densely ferrugineous- or cinereous-scaly, individual scales usually very conspicuous. *Leaves* opposite, subcoriaceous, densely scaly on both surfaces, individual scales usually conspicuous, lanceolate, ovate-lanceolate, narrowly elliptic or broadly elliptic to almost suborbicular, occasionally narrowly elliptic, usually about 7–10 by 4–7 cm (up to 18 by 11 cm in specimens from Burma) usually abruptly acuminate at the apex and rounded at the base; petiole 5–12 mm. *Inflorescence* a terminal panicle of elongated or pseudo-capitate spikes, the latter up to 7 cm long; rachis densely cinereous- or ferrugineous-scaly. *Flowers* yellowish,

fragrant, sessile, 4-merous. *Lower receptacle* (ovary)  $1\frac{1}{2}$ –2 mm long, densely ferrugineous-scaly otherwise glabrous. Upper receptacle 3–5 mm long measuring to the tips of the calyx-lobes, densely ferrugineous-scaly, lower part, containing the disk, infundibuliform, upper part cupuliform, terminating in 4 deltoid calyx-lobes less than 1 mm long. *Petals* 4, obovate, narrowly elliptic or oblanceolate, unguiculate, about  $1\frac{1}{2}$  mm long, glabrous. Disk infundibuliform, margin free for about 1 mm, barbate. Stamens 8, filaments  $3\frac{1}{2}$  mm long, anthers 0.6 mm long. *Fruit* usually suborbicular, sometimes obpyriform in outline, very variable in size and shape, sparsely scaly (densely when young),  $1.2$ – $2\frac{1}{2}$  by  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, with 4 thin, flexible wings, up to 1 cm broad.

Distr. India, Burma, Siam, Indo-China, and *Malaysia*: SW. Sumatra, Malay Peninsula, Java (W. half), Billiton, Borneo (SE. and Sarawak), and Philippines. Fig. 4.

*subsp. punctatum*.—*Combretum punctatum* BL. Bijdr. (1825) 640; MIQ. Fl. Ind. Bat. 1, 1 (1855) 607; KOORD. Exk. Fl. 2 (1912) 670 excl. syn. *C. sundaicum* MIQ.; SLOOT. Bijdr. Combr. (1919) 35; MERR. En. Born. (1921) 422; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 58; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 3.—*C. squamosum* (non ROXB. ex DON) MERR. En. Born. (1921) 423.—Fig. 2e.

Leaves lanceolate, ovate-lanceolate or narrowly elliptic. Inflorescence a terminal panicle of pseudo-capitate spikes. Petals obovate, unguiculate.

Distr. *Malaysia*: SW. Sumatra (Bencoolen), Java (W. half), and SE. Borneo.

Ecol. In submontane forest and bush, usually 1000–1600 m.

Vern. *Areuj mēngander*, *ki konēng*, *ojod djaha*, *S. marambat*, Bencoolen.

Note. This subspecies, nomenclaturally the typical one, is a submontane subspecies clearly separated altitudinally from the more widespread, lowland *subsp. squamosum*.

*subsp. squamosum* (ROXB. ex DON) EXELL, *comb. nov.*—*Combretum squamosum* ROXB. [Hort. Beng. (1814) 88 nom. nud.] ex DON, Trans. Linn. Soc. Lond. 15 (1827) 419, 438; Fl. Ind. 2 (1832) 231; MIQ. Fl. Ind. Bat. 1, 1 (1855) 607; KURZ, For. Fl. Burm. 1 (1877) 463; CLARKE in HOOK. f. Fl. Brit. Ind. 2 (1878) 456; KING, J. As. Soc. Beng. 66, 2 (1897) 339; MERR. Philip. J. Sc. C. Bot. 4 (1909) 649; SLOOT. Bijdr. Combr. (1919) 43; GAGNEP. Fl. Gén. I.-C. 2 (1920) 739; RIDL. Fl. Mal. Pen. 1 (1922) 709; MERR. En. Philip. 3 (1923) 148; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 58; CRAIB, Fl. Siam. En. 1 (1931) 620.—*C. distillatorum* BLANCO, Fl. Filip. (1837) 295.—*Poivreia squamosa* (ROXB. ex DON) WALP. Rep. 2 (1843) 64.—*C. lepidotum* PRESL, Bot. Bemerk. (1844) 142.—*C. laxum* (non JACQ. nec AUBL.) BLANCO, Fl. Filip. ed. 2 (1845) 206.—*C. squamosum var. luzonicum* PRESL, Abh. Kön. Böhm. Ges. Wiss. V, 6 (1851) 576.—*C. squamosum var. dissitum* CRAIB, Fl. Siam. En. 1 (1931) 620.—Fig. 2d.

Leaves broadly elliptic to almost suborbicular, occasionally narrowly elliptic. Inflorescence a terminal panicle of elongated spikes. Petals narrowly elliptic or lanceolate, unguiculate.

Distr. India, Burma, Siam, Indo-China, and Malaysia: Malay Peninsula, Billiton, Borneo (Sarawak), and Philippines.

Ecol. Woody climber in bush and secondary forest at low altitudes.

Vern. Philippines: *Libang-libang*, Mbo, *pamulaklak*, *malakadog*, Ilk., *malatumbága*, *tagarau*, Tag., *muli*, Sub.

**6. *Combretum portertianum* (CLARKE) WALL. ex CRAIB**, Fl. Siam. En. 1 (1931) 618.—*C. chinense* ROXB. ex DON, Trans. Linn. Soc. Lond. 15 (1827) 417, 432 *pro parte*?.—*C. chinense* var. *portertianum* CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 457; KING, J. As. Soc. Beng. 66, 2 (1897) 338; RIDL. Fl. Mal. Pen. 1 (1922) 709.

Scandent shrub. Young branchlets at first tomentellous, soon glabrescent. Leaves opposite, chartaceous, elliptic or narrowly elliptic, sparsely pubescent or glabrous, densely uniformly scaly and also usually with whitish rather sparse individually conspicuous scales or rather faintly visible scales on both surfaces, up to 14 by 7 cm, usually acuminate; petiole tomentellous or sparsely scaly,  $1\frac{1}{2}$ –1 cm. Inflorescence of axillary spikes c. 5 cm long or a terminal panicle of spikes c. 20 cm long; rhachides tomentellous or densely puberulous, sparsely and rather inconspicuously scaly. Bracts  $1\frac{1}{2}$  mm long. Flowers probably yellowish–white, sessile. Lower receptacle (ovary) densely ferruginous–scaly,  $1\frac{1}{4}$  mm long, somewhat constricted at the top. Upper receptacle  $2\frac{1}{2}$  mm long to the tips of the calyx-lobes, cupuliform at the top, terminating in the deltoid calyx-lobes,  $\frac{1}{2}$  mm long, with an infundibuliform basal part containing the disk, rather densely ferruginous lepidote, otherwise nearly glabrous. Petals 4, yellow, obovate,  $\frac{3}{4}$  mm long, emarginate at the apex, glabrous. Stamens 8; filaments 3 mm long; anthers  $\frac{1}{2}$  mm long. Disk infundibuliform, margin free for about 0.3 mm, glabrous inside, bearded on the margin. Style 2 mm. Fruit suborbicular in outline, 2– $2\frac{1}{2}$  cm diam., shortly stipitate, densely scaly on the body and sparsely so on the 4, thin, flexible wings, 5–7 mm broad.

Distr. Siam? and Malaysia: Malay Peninsula (Penang and Pahang). Fig. 4.

Ecol. Edges of forests and limestone cliffs.

Note. The type, G. PORTER in WALLICH 4000, from Penang, is in fruit. I have taken RIDLEY 5355, from Penang as representing the flowering stage and drawn up the description of the flowers from it.

For a note on the name '*C. chinense*' see under 7. *C. yunnanense*.

**7. *Combretum yunnanense* EXELL**, Sunyatsenia 1 (1938) 88, t. 21, f. F, t. 23.—*C. chinense* (an ROXB.?) SLOOT. Bijdr. Combr. (1919) 43; Bull. Jard. Bot. Btzg III, 6 (1924) 58.—*C. chinense* var. *pubescens* KING, J. As. Soc. Beng. 66, 2 (1897) 339; RIDL. Fl. Mal. Pen. 1 (1922) 709.

Scandent shrub or large climber. Young branchlets ferruginous–scaly, otherwise glabrous in the Malaysian specimens seen but pubescent at first in Chinese specimens. Leaves opposite or subopposite, rarely ternate, elliptic, oblong–elliptic or ovate–elliptic, rarely obovate, acuminate at the apex (rounded in some Assamese specimens) and rounded or cuneate at the base, with rather sparse, individually conspicuous usually golden or reddish scales on both surfaces, pubescent or glabrous, 4–12 by 3– $6\frac{1}{2}$  cm (up to 18 by 7 cm in Chinese specimens); nerves 6–9 pairs; petiole at first tomentose or pubescent later glabrescent, scaly, 3–10 mm. Inflorescences of axillary spikes up to 10 cm long and terminal panicles of spikes; rhachis ferruginous–scaly, tomentellous, finely pubescent or glabrous apart from the scales. Flowers sessile, 4-merous, white or yellowish. Lower receptacle (ovary) densely ferruginous–scaly, sometimes puberulous, 1–2 mm long. Upper receptacle infundibuliform at the base, cupuliform at the apex, 3 by  $2\frac{1}{2}$  mm, densely ferruginous–scaly, puberulous or glabrous (apart from the scales). Calyx-lobes triangular,  $\frac{1}{2}$  mm long. Petals 4, obovate or broadly elliptic, unguiculate, glabrous, 2 by  $1\frac{1}{2}$  mm. Stamens 8, filaments 3–4 mm long. Disk well-developed, densely pilose on the margin. Style 6– $6\frac{1}{2}$  mm long. Fruit suborbicular in outline,  $2\frac{1}{2}$ – $3\frac{1}{2}$  by  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm, ferruginous–scaly with 4 flexible wings 1 cm broad.

Distr. Bengal?, Assam?, Yunnan, and Malaysia: Sumatra, Malay Peninsula, and NW. Borneo.

Ecol. Little known. It grows up to 1600 m in Yunnan and may be a submontane species in Malaysia.

Note. The name *C. chinense* ROXB. ex DON has to be typified by a specimen in Herb. Lambert, collector unspecified, cited by DON and the conception given to the species by DON seems to differ in important respects from the original *C. chinense* ROXB. nom. nud. As I am uncertain whether *C. chinense* ROXB. ex DON applies to the species here described, to *C. portertianum* WALL. ex CRAIB. or possibly to a species not represented in Malaysia, I have had to treat the name, at least for the present, as a *nomen obscurum*.

**8. *Combretum borneense* EXELL**, J. Bot. 69 (1931) 265.

Woody climber. Young branchlets tomentellous, soon glabrescent. Leaves opposite, coriaceous, elliptic, narrowly elliptic, ovate–elliptic or suborbicular, somewhat shiny above, distinctly scaly above, scales spaced, not marginally contiguous, densely scaly below but scales not individually conspicuous, otherwise glabrous, 10–15 by 4–7 cm, abruptly acuminate at the apex, rounded or subcordate at the base; petiole 5–7 mm, at first pubescent, glabrescent. Inflorescence an ample terminal or axillary panicle up to 20 cm long, ultimate spikes 3–4 cm long. Bracts filiform, 2 mm long. Rhachis fulvous–pubescent. Flowers sessile, 4-merous. Lower receptacle (ovary) 2–3 mm long, densely scaly, scales marginally contiguous, otherwise glabrous. Upper receptacle shortly in-

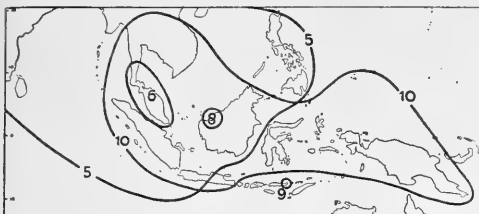


Fig. 4. Distribution of *Combretum*: 5. *punctatum*, 6. *porterianum*, 8. *borneense*, 9. *tetralophoides*, 10. *tetralophum*.

fundibuliform at the base, cupuliform at the apex with 4 acute, broadly triangular calyx-lobes, rather densely and conspicuously scaly, otherwise glabrous,  $2\frac{1}{2}$ –3 by 2.2 mm measuring to the tips of the calyx-lobes. *Petals* 4 oblanceolate, shortly clawed, glabrous,  $1\frac{3}{4}$  by  $\frac{3}{4}$  mm. *Stamens* 8, exserted, filaments  $3\frac{1}{2}$ –4.2 mm. *Disk* pilose with a shallow free margin. *Style* 5 mm. *Fruit* unknown.

*Distr. Malaysia*: Borneo (Sarawak). Fig. 4.

Note. Probably related to *C. tetralophum* CLARKE but only 3 collections are known and no fruits have yet been collected.

**9. *Combretum tetralophoides* SLOOT.** Bull. Jard. Bot. Btzig III, 6 (1924) 55.

Climbing shrub. Branchlets at first fulvous-tomentellous, later glabrescent. *Leaves* papyraceous, opposite, elliptic or oblong-elliptic, sparsely pubescent above, densely pubescent or almost tomentose beneath and densely scaly but individual scales not conspicuous, 6–11 by 4–5 cm, bluntly acuminate at the apex, cuneate at the base; nerves 5–8 pairs; petiole 3–5 mm, tomentellous. *Inflorescence* fulvo-tomentellous, a terminal or axillary panicle of spikes. Bracts linear, pubescent, 2 mm long, soon deciduous. *Flowers* sessile, 4-merous. *Lower receptacle* (ovary) densely ferruginous-scaly, 2 mm long, somewhat constricted above the ovary. Upper receptacle densely ferruginous-scaly, shortly and broadly infundibuliform at the base, c. 1 mm long, cupuliform at the apex and terminating in 4 broadly triangular calyx-lobes. *Petals* 4, linear-lanceolate, glabrous, 1– $1\frac{1}{2}$  mm long. *Stamens* 8, exserted. *Disk* small, densely pilose. *Fruit* broadly elliptic to obovate in outline, scaly but scales not very conspicuous, retuse at the apex and with a short,  $1\frac{1}{2}$  mm long stipe at the base; wings 4 thin, flexible c. 1 cm broad.

*Distr. Malaysia*: Lesser Sunda Islands (Flores: Larantuka), once collected. Fig. 4.

**10. *Combretum tetralophum* CLARKE** in HOOK. f. Fl. Br. Ind. 2 (1878) 454; KING, J. As. Soc. Beng. 66, 2 (1897) 336; SLOOT. Bijdr. Combr. (1919) 34; Bull. Jard. Bot. Btzig III, 6 (1924) 54; GAGNEP. Fl. Gén. I.-C. 2 (1920) 738; MERR. En. Born. (1921) 423; RIDL. Fl. Mal. Pen. 1 (1922) 708; HEYNE, Nutt. Pl. (1927) 1173; CRAIB, Fl. Siam. En. I

(1931) 621; BURK. Dict. (1935) 645; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 4.—*C. acuminatum* (non ROXB.) K. SCHUM. & HOLLR. Fl. Kais. Wilh.-Land (1889) 84; LAUT. Nova Guinea 8 (1910) 317; (1912) 847; DIELS, Bot. Jahrb. 57 (1912) 427, *quoad specim.* LEDERM. 7307.—*C. wrayi* KING, J. As. Soc. Beng. 66, 2 (1897) 339.—*C. tetragonocarpum* (non KURZ) KOORD. Minah. (1898) 453; KOORD.-SCHUM. Syst. Verz. 3, 1 (1914) 93.—*C. neurophyllum* (non MIQ.) BACKER, Bull. Jard. Bot. Btzig II, no 12 (1913) 12.—Fig. 2f.

Liana climbing to a considerable height or scandent shrub. Young branchlets ferruginous-scaly, soon glabrescent. *Leaves* opposite, papyraceous to chartaceous, elliptic, often shiny above, densely scaly but scales not individually conspicuous, otherwise nearly glabrous except for some pubescence, nearly always present, on the midrib at the base of the lower surface of the leaf, 6–15 (–20) by 3–6 (–11) cm, usually slightly or distinctly acuminate at the apex and cuneate or rounded at the base; nerves 6–8 pairs; petiole 3–10 mm long, scaly and often somewhat pubescent. *Inflorescences* scaly and pubescent, of lateral spikes and terminal panicles of spikes, spikes rarely more than 2–3 cm long and often subcapituliform. *Flowers* 4-merous, sessile, yellow, greenish yellow or greenish white, sweet-scented,  $4\frac{1}{2}$ – $7\frac{1}{2}$  mm long measuring to the tips of the calyx-lobes. *Lower receptacle* (ovary) 2– $2\frac{1}{2}$  mm long, densely ferruginous-scaly, otherwise glabrous, constricted at the apex; upper receptacle cupuliform at the apex, 1 by 3 mm, with 4 triangular acute calyx-lobes, basal portion containing the disk broadly infundibuliform,  $1\frac{1}{2}$  by 1 mm, densely ferruginous-scaly, otherwise usually glabrous. *Petals* 4, glabrous, oblanceolate,  $2\frac{1}{2}$ –3 by 0.8 mm. *Stamens* 8; filaments 4– $4\frac{1}{2}$  mm long; anthers  $\frac{1}{2}$  mm long. *Disk* well-developed with a short free margin, densely pilose so that the flowers appear barbate within. *Style* 6 mm long. *Fruit* ovoid or ovoid-ellipsoid in outline, densely scaly,  $2\frac{1}{2}$ –3.8 by 1.2–1.8 cm with 4 stiff, narrow, sharp-edged wings or ridges, along which it eventually dehisces.

*Distr.* Indo-China, Siam, Caroline Islands, in *Malaysia*: Sumatra, Malay Peninsula, Java, Borneo, Celebes, New Guinea; not recorded from Philippines. Fig. 4.

*Ecol.* In mangrove swamps and in fringing forests along banks of rivers in lowland regions. *Fruit* probably dispersed by water.

*Uses.* The fruits are used as a vermifuge but perhaps by confusion with those of *C. trifoliatum* or *Quisqualis indica*.

Vern. Akar aru, E. Borneo, songsong harus, susong harus, M, tingting, Celebes.

*Notes.* One specimen, EVANGELISTA 897 (A), from Br. N. Borneo, Labuan River, has much shorter and broader calyx-lobes, so that the flowers resemble those of *C. yunnanense*, but the leaves are undoubtedly those of *C. tetralophum*. Leaf-galls caused by a gall-mite are described by DOCTERS VAN LEEUWEN (Zooecid. Neth. E. I. 1926, 402, f. 749).

**11. *Combretum latifolium*** BL. Bijdr. (1825) 641, non *C. latifolium* DON (1827); MIQ. Fl. Ind. Bat. 1, 1 (1855) 609; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 52; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 4.—*C. extensum* ROXB. [Hort. Beng. (1814) 28 nom. nud.] ex DON, Trans. Linn. Soc. Lond. 15 (1827) 414, 422; KURZ, For. Fl. Burma 1 (1877) 463; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 458; KING, J. As. Soc. Beng. 66, 2 (1897) 337; MERR. Philip. J. Sc. C. Bot. 4 (1909) 649; BACK. Schooffl. Java (1911) 493; KOORD. Exk. Fl. 2 (1912) 670; SLOOT. Bijdr. Combr. (1919) 36; GAGNEP. Fl. Gén. Indo-Ch. 2 (1920) 737; MERR. En. Born. (1921) 422; En. Philip. 3 (1923) 148; RIDL. Fl. Mal. Pen. 1 (1922) 709; CRAIB, Fl. Siam. En. 1 (1931) 615.—*C. rotundifolium* ROXB. [Hort. Beng. (1814) 88 nom. nud.] Fl. Ind. 2 (1832) 226, non RICH. (1792).—*C. cyclophyllum* STEUD. Nom. ed. II, 1 (1841) 400.—*C. formosum* GRIFF. Not. Pl. As. 4 (1854) 682, non DON (1827).—*C. horsfieldii* MIQ. Fl. Ind. Bat. 1 (1855) 609.—*C. micropetalum* LLANOS, Mem. Acad. Cienc. Madr. 4 (1856) 502, non DC. (1828).—*C. leucanthemum* HEURCK & MÜLL. ARG. in HEURCK, Obs. Bot. (1870) 240.—*C. platyphyllum* HEURCK & MÜLL. ARG. op. cit. (1870) 242.—Fig. 1a, 1c.

Liana. Young branchlets scaly when very young, otherwise usually glabrous often reddish in colour. Leaves opposite, chartaceous to subcoriaceous, usually broadly elliptic or ovate-elliptic, sometimes suborbicular or elliptic, rarely narrowly elliptic (sucker shoots?) rather sparsely conspicuously scaly when young, when mature densely lepidote (under high magnification) but individual scales not conspicuous, otherwise glabrous, domatia often present but not hairy, 8–20 by 4–13 cm, often acuminate at the apex, acumen up to 1 cm long, cuneate or rounded at the base; petiole scaly when young, soon glabrescent, 7–20 mm long. Inflorescence a terminal or axillary panicle up to 20 cm long, of elongated 5–8 cm long spikes or occasionally an unbranched lateral spike, densely and finely velutinous. Bracts very small and soon caducous. Flowers greenish-white (occasionally pink?), 4-merous, subsessile. Lower receptacle (ovary) finely velutinous, 2½–3½ mm long. Upper receptacle finely velutinous narrowly tubular, 5–6

mm long, somewhat expanded at the apex and terminating in 4 narrowly triangular acute calyx-lobes 3 by 2 mm. Petals 4 suborbicular, glabrous, 2 by 2 mm, slightly emarginate at the apex and very shortly unguiculate at the base. Stamens 8 inserted at the margin of the disk; filaments 3½ mm long; anthers 0.8 mm long. Disk narrowly infundibuliform, margin thickened, free for about ½ mm, pilose. Style 8–8½ mm, rather stout. Fruit suborbicular (rarely obovate) in outline, 2–3 cm diam., with 4 thin, flexible wings, viscid-glandular especially on the body less so on the wings, shortly stipitate; stipe c. 2 mm long.

Distr. India, Ceylon, Burma, Indo-China, Siam, throughout Malaysia, the Moluccas and New Guinea excepted. Fig. 5.

Ecol. Widespread along margins of forest and in secondary forest, from sea-level up to 1000 m (fide BACKER), but most records are below 500 m.

Vern. *Areuj munding djalo*, *areuj tjikupa*, S, *londo*, *klundo*, *klondo*, *ojod klondo*, *ojod lundo*, J, *balimbing balimbing*, Bajau, *lamutagi*, SW. Celebes; Philippines: *suksukung*, Tagb., *dalipog*.

**12. *Combretum sundaicum*** MIQ. Fl. Ind. Bat. Suppl. (1860) 327; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 458; KING, J. As. Soc. Beng. 66, 2 (1897) 337 ('*sundiacum*'); BACK. Schooffl. Java (1911) 493; SLOOT. Bijdr. Combr. (1919) 38; Bull. Jard. Bot. Btzg III, 6 (1924) 54; RIDL. Mal. Pen. 1 (1922) 708; MERR. En. Philip. 3 (1923) 149; HEYNE, Nutt. Pl. (1927) 1173; CRAIB, Fl. Siam. En. 1 (1931) 620; BURK. Dict. (1935) 644; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 5.—Fig. 2g, 6.

Scandent shrub or liana up to 30 m. Young branchlets usually densely ferrugineous-scaly, otherwise glabrous or nearly so. Leaves opposite, chartaceous or papyraceous, usually broadly elliptic, sometimes nearly suborbicular, densely scaly but individual scales usually not very conspicuous in dried specimens (but occasionally conspicuous), often minutely verruculose on the upper surface, up to 15 by 10 cm (usually c. 11 by 7 cm in herb.), acuminate at the apex (rarely rounded, rarely caudate), rounded or obtuse at the base; petiole up to 2 cm long, often rather slender, usually densely (sometimes sparsely) ferrugineous-scaly, glabrescent. Inflorescence a terminal panicle of capituliform spikes or racemes, rhachis densely covered with reddish, golden-brown or greyish scales, otherwise usually glabrous. Bracts subtending the flowers, filiform, 1–2 mm long, soon caducous. Flowers greenish-white, 4-merous, subsessile. Lower receptacle (ovary) densely scaly otherwise glabrous, 3 mm long. Upper receptacle densely scaly otherwise glabrous or nearly glabrous, narrowly tubular, 5 mm long, somewhat expanded at the apex and terminating in 4 triangular acute calyx-lobes 2½ by 1½ mm, often reflexed in mature flowers. Petals 4 obovate to suborbicular, glabrous, 1½–2 by 1–2 mm, shortly unguiculate. Stamens 8 inserted at the margin of the disk; filaments 3 mm; anthers 0.8 mm long. Disk narrowly infundibuliform, margin

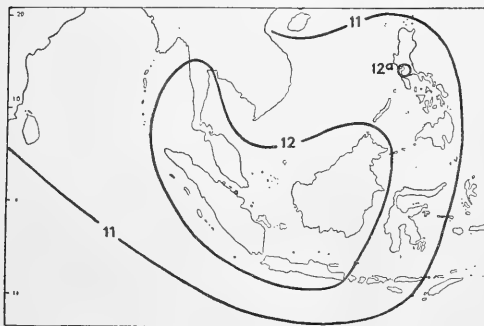


Fig. 5. Distribution of *Combretum*: 11. *latifolium*, 12. *sundaicum*, 12a. *confusum*.





Fig. 6. *Combretum sundaicum* MIQ. *a.* Flowering twig,  $\times 2/3$ , *b.* flower,  $\times 5$  (BARTLETT & DE LA RUE 45). *c.* fruit, nat. size (LÖRZING 1057).

free for about  $1/2$  mm, rather densely pilose. Style 8 mm. *Fruit* suborbicular in outline, somewhat glutinous, especially when young, with 4 thin flexible wings up to  $1\frac{1}{2}$  cm broad, not conspicuously lepidote; stipe 2–3 mm.

*Distr.* Siam and *Malaysia*: Sumatra, Malay Peninsula, Java, Borneo. Fig. 5.

*Ecol.* Climbing shrub or liana of open bush and edges of forest from sea-level to *c.* 250 m.

*Uses.* It has been used as a cure for opium-craving but is probably of little real value, the

supposed effect now being considered mainly psychological.

*Vern.* *Akar gambir*, *akar gëgambir*, *kait-kait*, *pugar tanar*, *M*, *bajit djaha*, Lampong, *sung-sung ajër*, Borneo.

*Note.* This species is very close to *C. latifolium* differing mainly in the capituliform spikes and in the scaly but otherwise glabrous inflorescences. The relationship between these species parallels that between *C. punctatum* and *C. squamosum* but is somewhat less close, as a



difference in the form of the inflorescence is correlated with a difference in indumentum (except for a few specimens which may be hybrids: see *C. confusum*). Hence *C. latifolium* and *C. sundaicum* have been maintained as separate species while *C. squamosum* and *C. punctatum* are considered to be only subspecifically distinct.

**12a. *Combretum confusum* MERR. & ROLFE**, Philip. J. Sc. C. Bot. 3 (1908) 116 (= *C. latifolium* × *C. sundaicum*?).—*C. sexalatum* MERR. Philip. J. Sc. 1, Suppl. 3 (1906) 212 *pro parte quoad fl.*

Similar to the last species in leaf characters but with inflorescences intermediate between those of *C. latifolium* and *C. sundaicum*, the ultimate spikes being slightly more elongated than in the latter species. The flowers are scaly like those of *C. sundaicum* but the rhachides and peduncles of the inflorescence are densely pubescent or tomentellous, much as in *C. latifolium*.

Distr. *Malaysia*: Philippines (Luzon). Fig. 5. Note. The three gatherings known are all from Luzon and may represent a hybrid between *C. latifolium* and *C. sundaicum*. Neither supposed parent is now known in Luzon but *C. latifolium* occurs in Palawan and *C. sundaicum* in Sarawak.

### Cultivated species

The following species are in cultivation in various Malaysian gardens: *C. assimile* EICHL., *C. coccineum* (SONN.) LAMK (*C. purpureum* VAHL), *C. flagrocarpum* CLARKE, *C. grandiflorum* DON, *C. paniculatum* VENT. (*C. pincianum* HOOK.), *C. pilosum* ROXB., *C. quadrangulare* KURZ, and *C. roxburghii* SPRENG. (*C. decandrum* ROXB.).

Of these the more attractive and widely grown species are: *C. coccineum*, *C. grandiflorum* and *C. paniculatum*. *C. grandiflorum* has occasionally established itself as an escape from cultivation in Penang.

### Excluded species

*Combretum flavo-virens* LAUT. Nova Guinea 8 (1912) 847 = *Pygeum dolichobotrys* K. SCHUM. & LAUT. (see DIELS, Bot. Jahrb. 57, 1922, 427) (*Rosac.*).

*Combretum sexalatum* MERR. Philip. J. Sc. 1 Suppl. 3 (1906) 212 *pro parte quoad fruct.* = *Aspidopteris elliptica* JUSS. (*Malpigh.*).

## 2. QUISQUALIS

LINNÉ, Sp. Pl. ed. 2, 1 (1762) 556; SLOOT. Bijdr. Combr. (1919) 45; Bull. Jard. Bot. Btzg III, 6 (1924) 59; EXELL, J. Bot. 69 (1931) 117.—*Quisqualis* RUMPH. Herb. Amb. 5 (1747) 71, t. 38.—*Kleinia* CRANTZ, Inst. (1766) 488, *non* JACQ. (1763).—*Sphalanthus* JACK in Mal. Misc. 2, no 7 (1822) 55.

Woody climbers. *Leaves* opposite or subopposite, entire, glabrous or hairy; petioles partly persisting after the fall of the leaf, their bases forming thorns. *Flowers* ♂, actinomorphic or slightly zygomorphic, 5-merous, in elongated, terminal or axillary bracteate (occasionally branched) spikes. *Receptacle* (calyx-tube) hairy or nearly glabrous, divided into a lower part (lower receptacle) surrounding and adnate to the ovary and a tubular to narrowly tubular upper part (upper receptacle) terminating in the calyx-lobes, the latter part caducous. *Calyx-lobes* 5, triangular, sometimes with filiform tips. *Petals* 5, rather large for the family and much exceeding the calyx-lobes, enlarging during anthesis. Stamens 10, biseriate, inserted inside and near the mouth of the upper receptacle. Anthers versatile. Disk narrowly tubular or absent. Style adnate for part of its length to the inner wall of the upper receptacle. Ovules 2-4; funicles sometimes papillose. *Fruit* dry, oblong, narrowed at both ends, deeply 5-sulcate between the longitudinal wings. Seed 1, longitudinally sulcate.

Distr. About 17 spp. of which 8 occur in tropical and South Africa, 8 in tropical Indo-Malaysia and 1, *Q. indica*, cultivated throughout the tropics, is probably indigenous both in tropical Africa and tropical Indo-Malaysia.

The Malaysian species belong to the following sections:  
sect. *Sphalanthus* (JACK) EXELL (*Q. conferta* and *Q. parvifolia*), and  
sect. *Euquisqualis* EXELL (*Q. indica* and *Q. sulcata*).

Ecol. Woody climbers along river-banks and margins of forests, mostly at low altitudes.

Uses. *Q. indica* is cultivated as an ornamental climber and the fruits are used as a vermifuge.

Notes. The genus as here delimited is separated from *Combretum* by the adnation of the style to the upper receptacle tube. For a full account of this question see EXELL, l.c.

KEY TO THE SPECIES

1. Petals less than 5 mm long. Upper receptacle (calyx-tube) not more than 2-5 cm long.
2. Upper receptacle (calyx-tube) 18-25 mm long. Branchlets tomentellous or pubescent. **1. *Q. conferta***
2. Upper receptacle (calyx-tube) about 10 mm long. Branchlets glabrous or nearly glabrous. **2. *Q. parvifolia***
1. Petals 7 mm long or longer in mature flowers (up to c. 20 mm). Upper receptacle (calyx-tube) 4-8 cm long.
3. Upper receptacle (calyx-tube) 4 cm long in mature flowers. Branchlets glabrous. Ovules 1-2. **3. *Q. sulcata***
3. Upper receptacle (calyx-tube) up to 8 cm long. Indumentum very variable but branchlets never quite glabrous. Ovules 3-4 . . . . . **4. *Q. indica***

**1. *Quisqualis conferta* (JACK) EXELL, J. Bot. 69 (1931) 122.**—*Sphalanthus confertus* JACK, Mal. Misc. 2, no 7 (1822) 55.—*Q. densiflora* WALL. [Cat. (1831) 4011 *nomen nudum*] ex MIQ. Fl. Ind. Bat. 1, 1 (1855) 611; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 460 *pro parte excl. spec. Moulm.*; KING, J. As. Soc. Beng. 66, 2 (1897) 341; GAGNEP. Fl. Gén. I.-C. 2 (1920) 773; RIDL. Fl. Mal. Pen. 1 (1922) 711; CRAIB, Fl. Siam. En. 1 (1931) 622.—*Sphalanthus ovatifolius* JACK ex STEUD. Nom. ed. 2, 2 (1841) 621, *nomen nudum*.

Young branchlets appressed-pubescent or tomentellous. *Leaves* opposite, papyraceous, elliptic, oblong-elliptic or obovate-oblong, glabrous except for domatia on the undersurface and a few hairs on the midrib, minutely verruculose above and beneath, 8-16 by  $3\frac{1}{2}$ -6 cm, acuminate at the apex and rounded (or sometimes very slightly cordate) at the base; nerves 5-6 pairs; petiole tomentellous, more or less glabrescent, 7-9 mm. Spikes terminal and axillary (occasionally branched), 6-12 cm long. Bracts narrowly elliptic, acuminate appressed-pubescent, 5-8 by  $1\frac{1}{2}$ -2 mm. *Flowers* red or white (?) turning colour during the day as in *Q. indica*, sessile, actinomorphic or slightly zygomorphic. *Lower receptacle* (ovary) sericeous,  $3\frac{1}{2}$ -4 mm long; upper receptacle narrowly tubular, pubescent, 18-25 mm long, slightly expanded at the apex, basal part slightly swollen on one side. *Calyx*-lobes with recurved filiform tips, 2-3 mm long. *Petals* oblong or elliptic, pubescent, 4 by 1.8 mm (about  $2\frac{1}{2}$  mm long in dried specimens). Longer stamens opposite the calyx-lobes with filaments 2 mm long; anthers 0.8 mm long. Disk narrowly tubular, slightly zygomorphic, glabrous, 10 by  $1\frac{1}{2}$  mm without free margin and not very clearly differentiated.

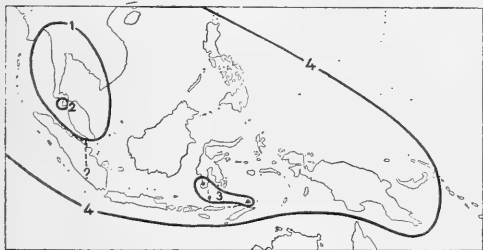


Fig. 7. Distribution of *Quisqualis*: 1. *conferta*, 2. *parviflora*, 3. *sulcata* (localities indicated by dots), 4. *indica*.

Style adnate to the upper receptacle for 20 mm; upper part free, 6 mm. Ovules 3. *Fruit* elliptic to ovate-elliptic in outline,  $2-2\frac{1}{2}$  by 1.8 cm with 5 thin, but rather stiff wings 6-7 mm broad, shortly stipitate, sparsely pubescent, somewhat viscid.

Distr. Indo-China, Siam, in *Malaysia*: Malay Peninsula (and Sumatra?, cf. JACK). Fig. 7.

Ecol. Presumably a forest-climber.

Uses. Apparently used indifferently with *Q. indica* as a vermifuge according to BURKILL (Dict. 1860); leaves or roots are used.

Vern. *Kayu sumang, sëlîmpas, sumang, akar dani, rêdani*, Mal. Pen.

Notes. This species is said to have been collected by WILLIAM JACK in Sumatra and a specimen, without precise locality, is in the DELESSERT Herbarium at Geneva and must be considered as the type. The species has never been collected again in Sumatra.

The 'disk' mentioned in this and the following species is not such an obviously independent structure as in most species of *Combretum* and *Terminalia* but rather a thickened portion of the basal part of the upper receptacle presumably secretory in function.

**2. *Quisqualis parvifolia* (RIDL.) EXELL, J. Bot. 69 (1931) 123.**—*Q. densiflora* var. *parvifolia* RIDL. Fl. Mal. Pen. 1 (1922) 711; CRAIB, Fl. Siam. En. 1 (1931) 623.

Branchlets very slender, glabrous or nearly so. *Leaves* minutely verruculose above, glabrous except for domatia and some pubescence on the midrib beneath, ovate-oblong, ovate-elliptic or elliptic, acuminate at the apex, rounded or subcordate at the base, 3-10 by  $1\frac{1}{2}$ -5 cm; nerves 3-4 pairs, rather prominent beneath; petioles 4-6 mm, glabrous. Spikes short, terminal or lateral with rachides 6-10 mm long. *Flowers* 'dirty mauve'. *Lower receptacle* (ovary) appressed-pubescent 2 mm long; upper receptacle tubular, 10 by  $2\frac{1}{2}$  mm, slightly swollen at one side in the basal part containing the disk, appressed-pubescent outside, glabrous inside. *Calyx*-lobes triangular, acute, 2 by 0.8 mm, tips  $\pm$  filiform but only  $\frac{1}{2}$ -1 mm long. *Petals* ovate, appressed-pubescent, 2 by  $1\frac{1}{2}$  mm. Filaments of longer stamens 2 mm, shorter ones  $1\frac{1}{2}$  mm; anthers  $\frac{1}{2}$  mm long. Disk infundibuliform, c. 2 mm long, not very clearly differentiated. Style adnate for 8 mm to the upper receptacle; free part  $2\frac{1}{2}$  mm. Ovules 2. *Fruit* not known.

Distr. *Malaysia*: NW. Malay Peninsula (Langkawi Islands). Fig. 7.



Fig. 8. *Quisqualis indica* L. with flowers and fruits,  $\times 2/3$ .

Notes. Clearly closely related to the preceding species but smaller in all its parts and with only 2 ovules in the ovaries of the few flowers available for dissection. The relation between this species and *Q. conferta* is almost the same as that between *Q. sulcata* and *Q. indica*.

3. *Quisqualis sulcata* SLOOT. Bijdr. Combr. (1919) 49; Bull. Jard. Bot. Btze III, 6 (1924) 61; EXELL, J. Bot. 69 (1931) 123.—*Q. sulcata* var. *subcordata* SLOOT. l.c. (1919) et (1924) 62; EXELL, l.c.—*Q. indica* (non L.) SLOOT. l.c. (1924) 61, *quoad spec.* TEYSMANN 12837.

Young branchlets reddish, glabrous. *Leaves* opposite, obovate or elliptic shortly acuminate at the apex, subcordate or rounded at the base, nearly glabrous, except for domatia on under-surface, minutely verruculose above, 10–19 by  $4\frac{1}{2}$ –8 cm; petiole 1.2–2 cm, glabrous, sulcate. Spikes shortly and densely hairy, terminal and axillary, 7–9 cm long. *Lower receptacle* (ovary) densely appressed-pubescent, 5–6 mm long; upper receptacle narrowly tubular, somewhat expanded at the apex with short appressed-pubescent on the outside and longer patent hairs within. *Calyx*-lobes broadly ovate,  $1\frac{1}{2}$  mm long. *Petals* oblong,

puberulous, rounded at the apex and rounded or slightly cuneate at the base, 12 by 6 mm. Filaments of longer stamens 9 mm, inserted opposite the calyx-lobes in the upper part of the upper receptacle, filaments of shorter ones 8 mm, inserted near the base of the petals *c.* 2 mm higher in the tube of the upper receptacle than the longer series; anthers 0.8 mm long. Style attached to the inside of the tube of the upper receptacle to within 2 mm of the attachment of the longer stamens at which it becomes free, free part 13 mm. Ovules 2. *Fruit* ellipsoid in outline, 3–3½ by 1.2–1.4 cm with 5 narrow stiff wings, at first appressed-pubescent, later glabrescent.

Distr. *Malaysia*: Lesser Sunda Islands (P. Wetar), Saleyer group (P. Kalao Toa, halfway Flores-SW.Celebes), and SW.Celebes (Maros). Fig. 7.

Ecol. Possibly on coral limestone, in Wetar in Eucalypt savannah, 0–50 m, fl. March–May.

Notes. Owing to lack of material I have not been able to verify VAN SLOOTEN's statement that this species has only 2 ovules, compared with 3 to 4 in *Q. indica*. If this distinction is true, in combination with the glabrousness of the twigs and the rather shorter upper receptacle it should be sufficient to maintain *Q. sulcata* as a good species. The difference given by VAN SLOOTEN in the shape of the petals proven on examination to be scarcely significant. Moreover, *Q. indica* is so variable as regards indumentum that the glabrous twigs in *Q. sulcata* could be regarded as no more than the end-point of a series of diminishing hairiness.

**4. *Quisqualis indica* LINNÉ, Sp. Pl. ed. 2, 1 (1762) 556; SIMS in CURT. Bot. Mag. t. 2033 (1819); BL. Bijdr. (1825) 642; BLANCO, Fl. Filip. (1837) 361; HASSK. Flora 27 (1844) 607; MIQ. Fl. Ind. Bat. 1, 1 (1855) 610; KURZ, For. Fl. Burma 1 (1877) 467; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 459; F-VILL. Novis. App. (1880) 81; VIDAL, Sinops. Atl. (1883) 26, t. 48, f. D; Phan. Cuming, Philip. (1885) 112; Rev. Vasc. Fl. Filip. (1886) 128; K. SCHUM. in K. SCHUM. & HOLLER. Fl. Kais. Wilh. Land (1889) 85; KING, J. As. Soc. Beng. 66, 2 (1897) 342; MERR. Philip. J. Sc. C. Bot. 4 (1909) 649; EN. BORN. (1921) 423; EN. Philip. 3 (1923) 154; BACK. Schoolfl. Jav. (1911) 494; KOORD. Exk. Fl. 2 (1912) 670; SLOOT. Bijdr. Combr. (1919) 46; GAGNEP. Fl. Gén. I.-C. 2 (1920) 776; RIDL. Fl. Mal. Pen. 1 (1922) 711; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 59; HEYNE, Nutt. Pl. N.I. (1927) 1173; CRAIB, Fl. Siam. En. 1 (1931) 623; EXELL, J. Bot. 69 (1931) 124; BURK. Dict. (1935) 1860; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 5.—*Quisqualis* RUMPH. Herb. Amb. 5 (1747) 71, t. 38.—*Kleinia quadricolor* CRANTZ, Inst. 2 (1766) 488.—*Q. pubescens* BURM. f. Fl. Ind. (1768) 104, t. 35, f. 2.—*Q. glabra* BURM. f. op. cit. 104, t. 28, f. 2.—*Q. spinosa* BLANCO, Fl. Filip. ed. 2 (1845) 254.—*Q. densiflora* (non WALL. ex MIQ.) F-VILL. Novis. App. (1880) 81.—Fig. 1d, 8, 9.**

Climbing to the left (MEEUSE). Young branchlets tomentose, villous, pilose, appressed-pubescent

or sparsely pubescent, rarely sparsely glandular. *Leaves* opposite or subopposite (said to be sometimes partly alternate, spiral or ± whorled—see SIMS and MEEUSE, *ll.cc.*), papyraceous, elliptic or elliptic-oblong, varying from tomentose to nearly glabrous, with domatia sometimes present, minutely verruculose on the upper surface, 5–18½ by 2½–9 cm, acuminate or sometimes subcaudate at the apex, rounded or subcordate at the base; nerves 5–6 pairs; petiole varying from tomentose to nearly glabrous, ½–2 cm; petiolar thorns sometimes up to 1½ cm. *Spikes* terminal and axillary, 2–10 cm long, sometimes forming a leafy panicle. Bracts lanceolate-acuminate or elliptic, 6–10 by 2–3 mm. *Flowers* pleasantly scented. *Lower receptacle* sericeous, 3–4 mm long; upper receptacle narrowly tubular, slightly expanded at the apex, outside varying from tomentose to nearly glabrous. *Calyx*-lobes deltoid or shortly triangular, 1–2 mm long, tips acute but scarcely filiform. *Petals* oblong, white, 6–8 mm, finally turning dark red, 10–20 by 3–6 mm, somewhat rounded and very shortly unguiculate at the base, imbricate in bud, sparsely pubescent. Filaments 7–7½ mm long, longer ones attached *c.* 1½ mm lower in the receptacle-tube than the shorter ones. Style adnate to the inner wall of the upper receptacle, upper part free for 15 mm. Ovules 3–4. *Fruit* dark-brown, ovate-elliptic in outline, usually appressed-pubescent, 2½–4 by ¾–1¼ cm with 5 rather stiff wings.

Distr. Widespread in the tropics of the Old World and widely planted in many tropical countries, throughout *Malaysia*. Fig. 7.

Ecol. A large climber along margins of primary forest, along river-banks, in thickets and in secondary forest; from sea-level to *c.* 100 (–300) m. Specimens maintain themselves by root-suckers and stooling.

Uses. Much grown as an ornamental climber in tropical gardens. In India and *Malaysia* fruits are often used as vermifuge; for this purpose they are picked half-ripe, when they are bitter, pulped in water and the liquid drunk. Seeds from ripe fruits may also be used. When ripe they taste like coconut (BURK. Dict. 1860). In Java the root is used as a vermifuge, or in E. *Malaysia* an extract from the mature leaves. Though many experiments have been carried out it is surprising that no active chemical substance has yet been isolated (*cf.* QUISUMBING, Medic. Pl. Philip. 1951, 654).

Very young shoots are used as a vegetable in Java (OCHSE, Veg. D. E. I. 1931, 106).

Vern. *Rangoon creeper*, *Burma creeper*, *Chinese honeysuckle*, E, *dani*, *udani*, *urdani*, *ara dani*, *akar dani*, *redani*, *wudani*, *sēlimpas*, *akar suloh*, M, *akar puntianak*, Mal. Pen., *bidani*, S, *katēkluk katjēkluk*, *tjēguk*, *tjēkluk*, J, *rabēt dani*, *kunji rabēt*, *rabēt bēsi*, Md, *saradēngan*, Kangean, *tikaō*, Bugin.; Philippines: *niog-niogan* (standard Tagalog name), *balitadham*, *pinion*, *piñones*, Bis., *bonor*, P. Bis., *kasunbal*, *tanglón*, *tagūlo*, Bik., *agūlo*, *tagūlo*, *totorauk*, *tagarau*, Tag., *talólóng*, Tag., Ilk., *tatúlong*, Ibn., *taúñgon*, Mbo, *tartaraok*, *tartarau*, Ilk.



Fig. 9. *Quisqualis indica* L. Botanic Gardens, Singapore, June 1950 (HENDERSON).

Notes. *Q. indica* varies very greatly as regards its form of growth and indumentum. This led RUMPHIUS to observe (*op. cit.* 72) 'Haec planta mihi Latine Quis qualis vocatur, acsi juxta Belgicum *Hoedanig* denominata esset, atque hoc nomen ipsi inposui ob multiplices, quas subit, mutationes, & variabilem formam' (See also SIMS, *l.c.*).

The petals are white when the flowers open in the early morning and gradually turn red as the

day advances. The flowers are adapted for pollination by only very long-tongued insects; fruiting specimens are rare from many localities.

A leaf-gall due to the gall-mite *Eriophyes quisqualis* NOL. has been recorded on the species (DOCTERS VAN LEEUWEN, *Zoocec.* N. I. 1926, 403).

Several experienced collectors have expressed the opinion that *Q. indica* is indigenous in tropical Africa and not merely an escape from cultivation.

### 3. TERMINALIA

LINNÉ, *Syst. Nat.* ed. 12, 2 (1767) 674 (*err.* 638) & *Mant. Pl.* (1767) 21 *nom. cons.*; SLOOT. *Bijdr. Combret.* (1919) 6; Bull. *Jard. Bot. Btzig* III, 6 (1924) 12.—*Adamarum* ADANS. *Fam.* 2 (1763) 445 *excl.* *Hort. Malab.* 4, t. 5.—*Myrobalanus* GAERTN. *Fruct.* 2 (1791) 90. t. 97, fig. 2.—*Gimbernatea* R. & P. *Prod. Fl. Peru* (1794) 138, t. 36.—*Pentaptera* ROXB. [*Hort. Beng.* (1814) 34, *nomen nudum*] *Fl. Ind.* ed. CAREY 2 (1832) 437.

Trees, often of great stature, frequently buttressed. Branching often sympodial. *Leaves* usually spirally arranged, often crowded in pseudo-whorls at the ends of the branchlets, usually petiolate, entire, glabrous or hairy, often minutely verruculose and pellucid-punctate due to aggregations of calcium oxalate crystals, rarely with canal-like mucilaginous cavities, often with domatia, frequently with 2 or more glands at or near the base of the lamina or on the petiole. *Flowers* actino-

morphic 5-merous (rarely 4-merous) usually in axillary spikes with ♂ flowers towards the apex and ♀ flowers towards the base, more rarely in terminal or terminal and axillary panicles; ♂ flowers stalked, stalks resembling pedicels but corresponding to the lower receptacle with abortion of the ovary; ♀ sessile. *Receptacle* (calyx-tube) glabrous or hairy, divided into a lower part (lower receptacle) surrounding and adnate to the ovary and often narrowed above it and an upper part, often scarcely developed, expanding into a shallow cup terminating in the calyx-lobes. *Calyx-lobes* deltoid, ovate or triangular. *Petals* absent. Stamens usually 10, exserted; anthers dorsifixed, versatile. Disk intrastaminal, usually barbate or densely pilose, occasionally glabrous or nearly glabrous, rarely little developed. Style simple, free, exserted. *Ovary* completely inferior, unilocular with 2 (rarely 3 or 4) pendulous ovules. *Fruit* (pseudocarp) very variable in size and shape, often fleshy and drupe-like, sometimes dry and leathery or corky, often 2-5-winged, usually with an at least partially sclerenchymatous endocarp (thus distinguishing it from the fruit of *Combretum*).

Distr. About 200 spp. throughout the tropics fairly equally distributed between tropical Asia, extending to northern Australia and Polynesia, tropical Africa and tropical America.

Ecol. The Malaysian species are mainly large evergreen or semideciduous trees of rain-forests, teak-forests, swamp forests and riverine forests. Some species are littoral and most occur at low altitudes, a few reaching 1600-2000 m. A number of species have fruits which are corky or contain air-chambers adapting them for distribution by water.

Wood anat. See under the species.

There is a marked tendency in Malaysian *Terminalia* spp. towards a crown habit, described and figured by CORNER as *pagoda trees*. CORNER says (Wayside Trees of Malaya p. 30):—'Their striking shape depends not only on the spacing of the limbs on the trunk but on their own peculiar branching whereby the leaves are set together in upturned posesses to form mats of foliage, there being one such mat for each tier of the crown: and, because this branching is typical of the genus of the *kétapang*, we have called it *Terminalia-branching*.' This is caused by sympodial growth. The pagoda habit is most conspicuous in saplings (fig. 18) and often disappears in the older trees as the branches droop at the ends and the crown is filled out. It has, however, often been mentioned in field notes as characteristic, for example in the following species: *T. archboldiana*, *T. calamansanai*, *T. hypargyrea*, *T. solomonensis*, and *T. subspathulata*.

As to bark characters only one species is remarkable, viz *T. brassii* in which the bark comes off in long, loose strips, so that the general appearance is reminiscent of some species of *Eucalyptus* and *Tristania*.

Most species possess a 'normal' leaf-size, some have large leaves, viz *T. adenopoda*, *T. catappa*, *T. darlingii*, *T. kaernbachii*, *T. zollingeri*, the largest-leaved of all being *T. copelandii* (up to 40 by 18 cm).

Most species occur in rain-forest, a few are apparently confined to semi-arid conditions, e.g. *T. crassifolia*, *T. microcarpa*, and *T. insularis*.

Deciduous species are, as far as known: *T. bellirica*, *T. calamansanai*, *T. canaliculata*, *T. catappa*, and *T. papuana*. This character is not correlated with occurrence in a monsoon climate.

CORNER (*l.c.* p. 192) says that species in the Malay Peninsula seem to be deciduous and flower after the new leaves have developed, but both the frequency with which they shed their leaves and the season differ markedly.

Uses. A considerable number of species provide useful timber. The fruits of some are edible and those of others are used for tanning and dyeing, especially the various species known collectively as *Myrobalans*.

Notes. The sections proposed in the genus are not entirely satisfactory and no useful purpose would be served by trying to fit the Malaysian species into them without a worldwide revision.

Apart from small differences in size and indumentum, the flowers of *Terminalia* are remarkably uniform in structure and offer few features of diagnostic value. The fruits, on the other hand are extremely variable and it is essential to use them for the making of keys. As the latter, and in the main the descriptions of the species, have perforce to be drawn up from dried material, the shapes and dimensions must necessarily be misleading to those who use the Flora with living specimens. Fleshy pericarps shrivel to a mere skin and except where information has been available from collectors' notes, the object described and measured is often merely the *endocarp* or *stone* of the fruit.

Too much attention should not be paid to the length of the lower receptacle in the descriptions for it begins to swell and to lengthen as the fertilized ovum develops. Only descriptions made from material at comparable stages of development would have diagnostic validity.

In comparing flowering and fruiting specimens and matching them up, a process not yet fully com-

pleted in this genus, it is perhaps superfluous to point out that when the lower receptacle is glabrous in the flowering stage a hairy fruit cannot result from it; but when the lower receptacle is sericeous the fruit, after swelling, will be at first appressed-pubescent. This indumentum may wear off as the fruit matures though traces of it can often be seen in furrows or near the base.

Some explanation of the 'pellucid punctuation' of the leaves is advisable. Aggregations of crystals of calcium oxalate cause minute warts usually on the upper and occasionally on the lower surface of the leaf. When held up to the light the leaf appears more or less pellucid-punctate. In very young, thin leaves these characters will not have developed; while as the leaf thickens with age they frequently disappear so that their diagnostic value is limited and their presence or absence in a description may be misleading and too much importance should not be attached to them.

A number of species, especially from Sumatra, Borneo, Celebes and New Guinea are still very insufficiently known. Sterile or imperfect material in herbaria shows that there are a number of new ones yet to be described; while several of those here enumerated may eventually be united when more collections have been made.

Finally, several species are very variable and have had to be inserted in more than one place in the key; so that when it seems uncertain which way to go it is possible to hope that either road will lead to the desired destination.

#### SYNOPSIS OF THE SPECIES in an attempted natural classification

**Series A.**—Flowers in terminal panicles probably all ♂. Leaves with a tendency to be opposite or sub-opposite. Species mainly of Indo-Malaysian distribution or affinity, approaching most nearly the genus *Combretum*.

*Subseries (a).* Fruits winged.

- |  |                         |
|--|-------------------------|
| Fruit small, 2-winged, wings broader than long . . . . . | 1. <i>T. myriocarpa</i> |
| Fruit 2-winged, wings longer than broad . . . . .        | 2. <i>T. brassii</i>    |
| Fruit usually 3-winged . . . . .                         | 3. <i>T. triptera</i>   |
| Fruit usually 4-winged . . . . .                         | 4. <i>T. polyantha</i>  |

*Subseries (b).* Fruits not winged. 'Myrobalans'.

- |                                     |                       |
|-------------------------------------|-----------------------|
| Fruit ellipsoid (fig. 14) . . . . . | 5. <i>T. citrina</i>  |
| (Fruit unknown) . . . . .           | 6. <i>T. creaghii</i> |

The introduced species *T. chebula* also comes here.

All succeeding series have spirally arranged leaves and all except series L have flowers in axillary spikes usually ♂ towards the apex and ♀ towards the base.

**Series B.**—Fruit 2-winged, broader than long (*i.e.* wings extended laterally). Species of Indo-Malaysian affinity.

- |                           |                            |
|---------------------------|----------------------------|
| Fruit pubescent . . . . . | 7. <i>T. calamansanai</i>  |
| Fruit glabrous . . . . .  | 8. <i>T. subspathulata</i> |

**Series C.**—Fruit laterally compressed usually longitudinally circumalate or circum-ridged. Mainly endemic species confined to East Malaysia.

*Subseries (a).* Leaves spatulate to obovate, coriaceous. Species from the Philippines, Celebes, and New Guinea.

- |  |
|--|
| 9. <i>T. kjellbergii</i> , 10. <i>T. surigaensis</i> , 11. <i>T. darlingii</i> , 12. <i>T. slooteniana</i> , 13. <i>T. supitiana</i> , 14. <i>T. clemensae</i> (fig. 14), 15. <i>T. steenisiana</i> (fig. 14). |
|--|

*Subseries (b).* Leaves narrowly elliptic to obovate, often silvery or rufous-sericeous especially when young. Endemic New Guinea species, except *no* 19 which is widespread in the Archipelago and *no* 20 which extends to the Solomon Islands.

- |   |
|---|
| 16. <i>T. oreadam</i> , 17. <i>T. sepicana</i> (fig. 14), 18. <i>T. rubiginosa</i> , 19. <i>T. microcarpa</i> (fig. 14), 20. <i>T. complanata</i> (fig. 14), 21. <i>T. hypargyrea</i> (fig. 14), 22. <i>T. sogerensis</i> , 23. <i>T. longespicata</i> (fig. 14, 16). |
|---|

**Series D.**—Leaves obovate, subcordate at the base. Fruit usually compressed, circumalate or circum-ridged. Littoral species of Tropical Asia-N.Australia-Polynesia distribution . . . . . 24. *T. catappa*

**Series E.**—Leaves obovate, usually coriaceous, not subcordate at the base. Fruit relatively small, ± laterally compressed. Littoral species of Polynesian affinity.

- |   |                           |
|---|---------------------------|
| Fruit considerably compressed, <i>c.</i> 2 cm long (fig. 14) . . . . .                        | 25. <i>T. samoensis</i>   |
| Fruit little compressed, <i>c.</i> 1½ cm long. Leaves sparsely appressed-pubescent . . . . .  | 26. <i>T. crassifolia</i> |
| Fruit little compressed, 1½–2 cm long. Leaves densely, softly pubescent at time of flowering. | 27. <i>T. insularis</i>   |

**Series F.**—Leaves typically broadly elliptic to suborbicular, sometimes with petioles nearly as long as the lamina. Fruit subglobose to broadly ellipsoid, little compressed, often 5-ridged, tomentellous. Species of Indo-Malaysian distribution, also known as a 'Myrobalan' (fig. 14). . . . . 28. *T. bellirica*



**Series G.**—A probably heterogeneous group of species with ellipsoid (not compressed) fruits with scler-enchymatous endocarp, about 2½–7 cm long. Leaves rarely more than 25 cm long, usually not exceeding 20 cm. Species mostly endemic to Malaysia.

- 29. *T. macadamii* (fig. 14), 30. *T. solomonensis*, 31. *T. kangeanensis* (fig. 14), 32. *T. celebica* (fig. 14), 33. *T. beccarii*, 34. *T. soembawana* (fig. 14), 35. *T. nitens* (fig. 22), 36. *T. lundquistii* (fig. 22), 37. *T. plagata* (fig. 22), 38. *T. pellucida* (fig. 22), 39. *T. papuana* (fig. 22), 40. *T. zollingeri* (fig. 24).

**Series H.**—Fruit subglobose or ellipsoid with a spongy, fibrous or corky pericarp. Leaves not more than 20 cm long. Sumatra, Malay Peninsula, Borneo and Philippines. Species of Indo-Malaysian affinities.

- Fruit 3½–5 cm long. Leaves up to 19 cm long (fig. 22, 25) . . . . . 41. *T. foetidissima*  
Fruit 3½ cm in diam. subglobose. Leaves up to 7 cm long (fig. 22) . . . . . 42. *T. molii*  
Fruit 6–7 by 4½ cm. Leaves up to 8 cm long (fig. 22) . . . . . 43. *T. phellocarpa*

**Series I.**—Leaves often very large, up to 40 cm long, lateral nerves often numerous and prominent. Fruit up to 17½ cm long (*T. kaernbachii*). Malaysian-Melanesian species.

- Fruit 3½–6 cm long. Lateral nerves 15–40 pairs (fig. 29) . . . . . 44. *T. copelandii*  
Fruit up to 8–17½ cm long. Lateral nerves 10–18 pairs (fig. 29) . . . . . 45. *T. kaernbachii*  
(Fruit unknown, perhaps belongs here) . . . . . 46. *T. adenopoda*

**Series J.**—Leaves manifestly canaliculate showing distinct striae on the supper surface when viewed with a lens. The affinity may be with series G . . . . . 47. *T. canaliculata*

**Series K.**—Leaves small, obovate, coriaceous, 3–7 cm long. Fruits small, 8 by 7 mm (perhaps immature). A New Guinean species of doubtful affinity . . . . . 48. *T. archboldiana*

**Series L.**—Flowers in pseudo-capitulae. Species endemic to New Guinea . . . . . 49. *T. capitulata*

**Unplaced.**—Known only from leaves . . . . . 50. *T. oxyphylla*

KEY TO THE SPECIES

- 1. Leaves without linear translucent mucilage canals clearly visible on the upper surface of the leaves, though sometimes pellucid-punctate.
- 2. Flowers in axillary spikes or terminal panicles (not pseudo-capitulae).
- 3. Fruit (including wings) broader than long.
- 4. Fruit (including wings) usually c. 1 cm broad (occasionally up to 1.6 cm). Flowers in terminal panicles . . . . . 1. *T. myriocarpa*
- 4. Fruit (including wings) at least 2 cm broad. Flowers in axillary spikes or, more rarely, in terminal panicles.
- 5. Fruit finely pubescent or tomentellous, especially on the body, less so on the wings . . . . . 7. *T. calamansanai*
- 5. Fruit glabrous when mature. Leaves glaucous beneath . . . . . 8. *T. subspathulata*
- 3. Fruit orbicular or ovate in outline, or longer than broad, variously winged or ridged, or not winged, terete or flattened.
- 6. Upper receptacle and calyx remaining attached to the apex of the developing fruit. Leaves usually oblong, rounded at the base with 20–35 pairs of lateral nerves. Flowers in terminal and axillary panicles . . . . . 2. *T. brassii*
- 6. Upper receptacle and calyx early deciduous.
- 7. Fruit 3–5-winged (not merely at the apex). Flowers in panicles.
- 8. Fruit 3-winged, 1½–2 cm long. Flowers 1–1½ mm in diameter . . . . . 3. *T. triptera*
- 8. Fruit 4–5-winged (exceptionally 3-winged), 1½ cm long. Flowers 1½–2 mm in diameter. . . . . 4. *T. polyantha*
- 7. Fruit not 3–5-winged (except occasionally at the apex only), either circumalate, with 2 wings generally confluent at the apex and usually also at the base or without wings (though sometimes ridged or angled).
- 9. Fruit longitudinally circumalate (sometimes not completely so at the base or apex) usually laterally compressed. Wing sometimes as narrow as 2–3 mm but clearly more than a mere ridge or angle (border-line cases will be found in both halves of the key). Two or three additional longitudinal ridges sometimes present.
- 10. Leaves not subcordate at the base.
- 11. Fruit not (or very rarely) more than 2½ cm long (up to 2.7 cm in *T. microcarpa*).
- 12. Fruit glabrous when mature.
- 13. Fruit ovate in outline . . . . . 9. *T. kjellbergii*
- 13. Fruit suborbicular in outline, emarginate at the apex . . . . . 10. *T. surigaensis*
- 12. Fruit pubescent.



14. Fruit suborbicular in outline, somewhat emarginate at the apex. Leaves up to 26 cm long, much narrowed at the base . . . . . **11. T. darlingii**
14. Fruit flattened ellipsoid. Leaves c. 12 cm long (fig. 14) . . . . . **19. T. microcarpa**
11. Fruit 3 cm long or longer.
15. Fruit suborbicular or very broadly elliptic in outline.
16. Fruit not more than 3 cm long . . . . . **11. T. darlingii**
16. Fruit  $7\frac{1}{2}$  by 6 by 3 cm, resembling a diminutive tortoise in shape . . . . . **12. T. slooteniana**
15. Fruit elliptic or ovate in outline.
17. Mature fruit glabrous.
18. Fruit elliptic or narrowly elliptic in outline.
19. Wings of fruit 5–7 mm broad. Leaves narrowly obovate or spatulate. **13. T. supitiana**
19. Wings of fruit 1–3 mm broad, sometimes scarcely developed.
20. Fruit  $3\frac{1}{2}$  cm long. Receptacle sericeous. Leaves up to 10 cm long (fig. 14). . . . . **16. T. oreadum**
20. Fruit  $5\frac{1}{2}$ –7 cm long. Leaves up to 20 cm long (fig. 14) . . . . . **14. T. clemensae**
18. Fruit ovate to broadly elliptic in outline, up to  $3\frac{1}{2}$  cm long. Receptacle glabrous. Leaves elliptic or obovate-elliptic, usually shiny above (fig. 14) . . . . . **15. T. steenisiana**
17. Mature fruit pubescent or tomentellous.
21. Leaves fulvous-pubescent on the nerves beneath (fig. 14) . . . . . **17. T. sepicana**
21. Leaves rufous-tomentellous on the nerves beneath . . . . . **18. T. rubiginosa**
10. Leaves usually subcordate at the base, obovate, with a short, thick petiole; deciduous. . . . . **24. T. catappa**
9. Fruit not winged, sometimes with 2–5 longitudinal ridges.
22. Fruit laterally compressed so that, in dried specimens the longer axis of the transverse section is at least  $1\frac{1}{2}$  times the shorter axis. (In fresh specimens the endocarp or 'stone' should be measured.)
23. Fruit 1–2 cm long (occasional fruits reaching  $2\frac{1}{2}$  cm).
24. Fruit glabrous, the sclerenchymatous endocarp containing many small air-spaces. Leaves obovate or broadly obovate (fig. 14) . . . . . **25. T. samoensis**
24. Fruit pubescent or sericeous (if pubescent with traces of indumentum remaining). Leaves elliptic to obovate-elliptic.
25. Endocarp of fruit densely sclerenchymatous without air-chambers . . . . . **19. T. microcarpa**
25. Endocarp of fruit with radial plates of sclerenchyma separated by large air spaces.
26. Leaves with up to 12 pairs of lateral nerves, typically elliptic (fig. 14). **20. T. complanata**
26. Leaves with up to 16 pairs of lateral nerves, typically obovate-elliptic. **23. T. longespicata**
23. Fruits more than 2 cm long.
27. Leaves not subcordate at the base. Fruit 2–4 cm long.
28. Leaves obovate or narrowly obovate.
29. Young parts rufous-tomentose, sometimes glaucous beneath . . . . . **41. T. foetidissima**
29. Young parts silvery or rufous-sericeous. Leaves not glaucous beneath (fig. 14). . . . . **21. T. hypargyrea**
28. Leaves oblong, elliptic or oblanceolate.
30. Leaves with up to 16 pairs of lateral nerves, rufous-tomentose, -tomentellous or -pubescent (fig. 14, 16) . . . . . **23. T. longespicata**
30. Leaves with 6–12 pairs of lateral nerves.
31. Fruit suborbicular in outline, sometimes beaked.
32. Leaves appressed-pubescent beneath. Lateral veins regularly parallel, sharply ascending and usually about 4–8 mm apart . . . . . **20. T. complanata**
32. Leaves with a dense, silky, red, silvery or golden indumentum (sometimes glabrescent when mature). Lateral nerves less regularly parallel than in the preceding species.
33. Bracts of inflorescence 2–3 mm long. Indumentum of leaves and inflorescences silvery or golden (in dried specimens). Leaves obovate to elliptic . . . . . **21. T. hypargyrea**
33. Bracts of inflorescence 4–6 mm long. Indumentum of leaves and inflorescences golden-red to red (in dried specimens). Leaves narrowly elliptic or narrowly obovate-elliptic . . . . . **22. T. sogerensis**
31. Fruit elliptic in outline . . . . . **16. T. oreadum**
27. Leaves usually subcordate at the base. Fruit usually more than 4 cm long. **24. T. catappa**
22. Fruit terete or nearly terete in transverse section or if somewhat laterally compressed then the longer axis of the transverse section less than  $1\frac{1}{2}$  times the shorter axis.
34. Flowers in panicles. Leaves often opposite or subopposite.
35. Leaves coriaceous shiny, with numerous conspicuous parallel tertiary veins on lower surface. (Fruit unknown.) . . . . . **6. T. creaghii**
35. Leaves without conspicuous parallel tertiary veins on the lower surface (fig. 14). **5. T. citrina**
34. Flowers in axillary spikes.
36. Fruit not more than 5 cm long.

37. Fruit not more than  $1\frac{1}{2}$  cm long.
38. Leaves softly and densely pubescent at time of flowering, 8–17 cm long. 27. *T. insularis*
38. Leaves sparsely appressed-pubescent or glabrous.
39. Leaves 6–13 cm long. Fruit  $1-1\frac{1}{2}$  cm long. Branchlets rather stout. 26. *T. crassifolia*
39. Leaves 3–9 cm long. Fruit 1 cm long. Branchlets slender . . . 48. *T. archboldiana*
37. Fruit 2–5 cm long.
40. Leaves usually subcordate at the base.
41. Lateral nerves 8–13 pairs. Inflorescences 8–20 cm long. . . . . 24. *T. catappa*
41. Lateral nerves 18–30 pairs. Inflorescences often more than 30 cm long. 44. *T. copelandii*
40. Leaves not subcordate at the base.
42. Fruit tomentellous. Petioles 3–6 cm long (fig. 14) . . . . . 28. *T. bellirica*
42. Fruit glabrous or sparsely hairy.
43. Mature leaves fulvous or rufous-tomentose at least on the nerves below.
44. Fruit over 4 cm long. Leaves narrowly obovate or narrowly obovate-elliptic.
40. *T. zollingeri*
44. Fruit  $2\frac{1}{2}$ –3 cm long. Leaves elliptic or broadly elliptic (fig. 14). 29. *T. macadamii*
43. Mature leaves not tomentose beneath (except sometimes on the petioles when young).
45. Leaves elliptic or obovate-elliptic, greatest breadth usually between  $\frac{1}{2}$  and  $\frac{2}{3}$  of distance from base to apex.
46. Flowers sericeous outside.
47. Fruit subglobose  $3\frac{1}{2}$  by 3 cm (fig. 22) . . . . . 42. *R. molii*
47. Fruit ellipsoid.
48. Fruit  $1\frac{1}{2}$ –2 times as long as broad.
49. Petioles  $3\frac{1}{2}$ –5 cm long, usually with 2 glands near the centre. Fruit  $3\frac{1}{2}$ –4 cm long (New Guinea and Solomon Isl.) . . . . . 30. *T. solomonensis*
49. Petioles 2–3 cm long; glands obsolete or rather inconspicuous at the base of the lamina. Fruit  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long (Java, Kangean Arch.) (fig. 14). 31. *T. kangeanensis*
48. Fruit  $2\frac{1}{2}$ –3 times as long as broad, sclerenchyma of endocarp stellate in transverse section (fig. 14) . . . . . 32. *T. celebica*
46. Flowers glabrous outside.
50. Petiole  $2\frac{1}{2}$  cm long. Leaves not shiny above, up to 14 by  $7\frac{1}{2}$  cm. (Fruit unknown; position perhaps here) . . . . . 33. *T. beccarii*
50. Petiole not more than 2 cm long. Leaves  $\pm$  shiny above.
51. Fruit 3– $3\frac{1}{2}$  cm long. Leaves up to 20 by 11 cm, somewhat shiny above (fig. 14). 34. *T. soembawana*
51. Fruit up to 5 cm long. Leaves up to 15 by 9 cm.
52. Fruit not verrucose. Leaves very shiny above . . . . . 35. *T. nitens*
52. Fruit verrucose. Leaves not very shiny above, glutinous beneath (fig. 22). 36. *T. lundquistii*
45. Leaves narrowly obovate to obovate or oblanceolate, usually rounded at the apex (though often also apiculate), greatest breadth within the apical third of the leaf.
53. Flower-buds glabrous (calyx-teeth, upper receptacle and lower receptacle glabrous on the outside).
54. Leaves not minutely verruculose on the upper surface, usually intensely shiny above and drying (in the specimens seen) a dark chocolate brown (fig. 22). 35. *T. nitens*
54. Leaves usually minutely verruculose on the upper surface when adult; upper surface of leaf (when dried) dull or somewhat shiny.
55. Leaves up to 20 by 11 cm. Lateral nerves 9–13 pairs. . . . . 34. *T. soembawana*
55. Leaves rarely more than 12 cm long (occasionally up to 17 by 9 cm). Lateral nerves 5–10 pairs.
56. Petiole sericeous. Reticulation prominent on the upper surface of the leaf (fig. 22) . . . . . 37. *T. plagata*
56. Petiole glabrous. Reticulation not very prominent on the upper surface of the leaf (fig. 22) . . . . . 38. *T. pellucida*
53. Flower-buds hairy, especially on the lower receptacle (fig. 22, 25). 41. *T. foetidissima*
36. Fruit more than 5 cm long.
57. Leaves subcordate at the base.
58. Lateral nerves 8–13 pairs. Inflorescences 8–20 cm long . . . . . 24. *T. catappa*
58. Lateral nerves 18–30 pairs. Inflorescences up to 30 cm long (fig. 29) . . . . . 44. *T. copelandii*
57. Leaves not subcordate at the base.
59. Mature leaves rufous-tomentose on the nerves beneath, up to 30 cm long.
60. Petiole about 5 mm long. Fruit  $4\frac{1}{2}$ – $7\frac{1}{2}$  cm long (fig. 24) . . . . . 40. *T. zollingeri*
60. Petiole usually 15–30 mm long. Fruit 8–17 cm long (fig. 29) . . . . . 45. *T. kaernbachii*
59. Mature leaves nearly glabrous.

61. Leaves up to 8 cm long. Fruit 6–7 cm long; pericarp corky (fig. 22). 43. *T. phellocarpa*  
 61. Leaves up to 17 cm long. Fruit 5–6 cm long; pericarp not corky (fig. 22). 39. *T. papuana*  
 2. Flowers in pseudo-capitulae . . . . . 49. *T. capitulata*  
 1. Leaves with linear translucent mucilage canals clearly visible (especially with a lens) on the upper surface . . . . . 47. *T. canaliculata*

*Flowers and fruits unknown (Sumatra)*

Leaves nearly glabrous up to 35 by 12 cm. Lateral nerves 14–17 pairs . . . . . 46. *T. adenopoda*  
 Leaves glabrous, crowded at the ends of the branches, narrowly elliptic up to 20 by 6½ cm. 50. *T. oxyphylla*

**1. Terminalia myriocarpa** HEURCK & MÜLL. ARG. Obs. Bot. (1870) 215; KURZ, For. Fl. Burm. 1 (1877) 457; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 448; GAGNEP. Fl. Gén. I.-C. 2 (1920) 760.—*Myrobalanus myriocarpa* KUNTZE, Rev. Gen. Pl. (1891) 237.

Large, evergreen tree. Young branchlets tomentellous sometimes rapidly glabrescent. *Leaves* subopposite, at first tomentellous or appressed-pubescent, often glabrescent when mature, oblong, oblong-elliptic or oblong-lanceolate, 8–20 by 2–8 cm, pointed at the apex, rounded or subcordate at the base; nerves up to 20–30 pairs; petiole tomentellous often glabrescent, relatively short and thick, 3–4(–7) mm, often 1 or 2 conspicuous glands (sometimes stalked) at the apex of the petiole or at the base of the lamina. *Flowers* small, sessile, numerous, ♂, protogynous, in large terminal fulvous-tomentellous panicles; bud subglobose, nearly glabrous towards the apex. *Lower receptacle* (ovary) sericeous, ¾–1 mm long; upper receptacle nearly glabrous, cupuliform, 0.8 by 0.8 mm. *Calyx*-lobes deltoid, ½ mm long. Filaments glabrous, 1½ mm; anthers ½ mm long. Disk poorly developed. Style glabrous, 2 mm. *Fruit* fulvous-sericeous, body compressed-ellipsoid or obscurely trigonal, 3–4 by 1–1½ mm, expanded laterally into 2 thin pubescent transversely oblong wings, 2–4 by 5–6 mm, with occasional rudimentary development of a third wing.

Distr. India (Sikkim, Assam), Upper Burma, China (Yunnan), Indo-China, in *Malaysia*: N. Sumatra. Fig. 10.

Ecol. Primary forests, 1000–2000 m.

Wood anat. PEARSON & BROWN, Comm. Timb. 1 (1932) 530.

Uses. The timber is said to be excellent, the wood being white and hard.

Vern. *Sěntalon*, Gajo.

Note. GRIFFITH 407 (BM) has a printed label 'Malacca' but a specimen in Herb. VAN HEURCK, which may well be the same collection, is labelled 'Khasiya'. The species is not recorded in botanical works on the Malay Peninsula. The fruits are smaller than those of *T. paniculata* ROTH with which it can easily be confused.

**2. Terminalia brassii** EXELL, J. Bot. 73 (1935) 134.

Large, flange-buttressed tree, up to 50 m. Bark scaly brown. Young branchlets tomentose or nearly glabrous. *Leaves* alternate or sometimes subopposite, subcoriaceous, varying from tomentose to nearly glabrous, narrowly oblong, narrowly oblong-elliptic, oblong-elliptic or elliptic 5–9 by

3–6 cm, usually gradually narrowed and pointed at the apex (sometimes rounded) rounded or subcordate at the base; nerves 20–35 pairs; petiole tomentose-pubescent or glabrous 5–10 mm, with 2 conspicuous, glabrous suborbicular glands at or near the apex. *Flowers* pale green sessile in terminal and axillary panicles 8–13 cm long; rachis tomentose. *Lower receptacle* (ovary) tomentose 1½–2 mm long elongating to 5–8 mm before the wings develop; upper receptacle cupuliform 1 by 1–2 mm, persistent; *calyx*-lobes scarcely developed. Filaments 2½–3½ mm; anthers 0.3 mm long. Disk rather fleshy, pilosulose. Style glabrous, 2½ mm. *Fruit* pubescent suborbicular, obovate or ovate in outline, 1–1½ by 0.8–1.3 cm, with 2 well-developed thin flexible wings and 3 rudimentary ones, crowned at the apex by the remains of the persistent calyx.

Distr. Solomon Islands (Ysabel, San Christobal, Bougainville) and New Britain. Fig. 10.

Ecol. A large tree of lowland and riverine rain-forest.

Uses. The sapwood is pale brownish-yellow, porous, straight-grained, somewhat stringy and of medium weight (according to E. P. HOLMES). It is probably not in commercial use.

Notes. The bark comes off in long, loose strips so that the general appearance is reminiscent of some species of *Eucalyptus* or *Tristania*. Young trees often send out stiff, horizontal adventitious roots high above the ground.

**3. Terminalia triptera** STAFF, Kew Bull. (1895) 103; RIDL, Fl. Mal. Pen. 1 (1922) 706; CRAIB, Fl. Siam. En. 1 (1931) 608.

Small tree, 3–10 m. Young branchlets sometimes pubescent at first, soon becoming glabrous. *Leaves* alternate or subopposite, chartaceous or papyraceous sparsely pubescent beneath or glabrous, rather obscurely minutely verruculose on the upper surface and obscurely pellucid-punctate, ovate, ovate-elliptic, elliptic or obovate, usually slightly acuminate, acute or blunt at the apex, rounded or cuneate at the base, 3–8 by 1½–3½ cm; petiole pubescent often glabrescent, slender, 5–10 mm. *Flowers* cream, protogynous, apparently all ♂, in terminal and axillary panicles 2½–4 cm long; rachides densely pubescent. Bracts pubescent, filiform, 1 mm. *Lower receptacle* (ovary) glabrous, 0.8 mm long, upper receptacle shallowly cupuliform glabrous, ½ by 1 mm, with broadly ovate *calyx*-lobes c. 0.6 mm long. Filaments glabrous, 3 mm; anthers 0.3 mm long. Disk densely pilose. Style glabrous, 2½ mm. *Fruits* 3-winged, 10–20 by

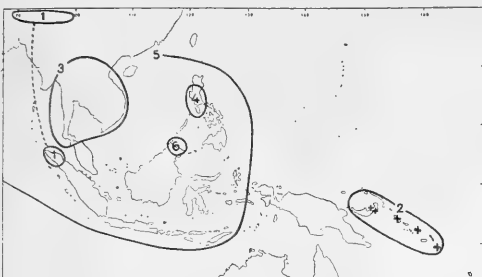


Fig. 10. Distribution of *Terminalia* series A: 1. *myriocarpa*, 2. *brassii* (localities indicated), 3. *triptera*, 4. *polyantha*, 5. *citrina*, 6. *creaghii*.

6–12 mm, glabrous or nearly glabrous, often somewhat oblique.

Distr. Siam, Indo-China, in *Malaysia*: NW. Malay Peninsula (N. Kedah: Langkawi Islands and Alor Star). Fig. 10.

Ecol. A small tree common on limestone in the Langkawi Islands, also on quartzite and shale, up to 100 m.

Vern. *Tan, tau, titau*.

Notes. This species is closely related to *T. polyantha* PRESL. The fruits of the latter are usually 4–5-winged but one specimen (SULIT PNH 7444 from Luzon) has all the fruits 3-winged and approaches *T. triptera* very closely. The differences between the two species as far as can be ascertained from the material available are:

*T. polyantha*:—Fruit usually 4-winged, rarely 3-winged or 5-winged, 0.8–1½ cm long, symmetrical. Flowers 1½–2 mm in diam.

*T. triptera*:—Fruits always 3-winged, 1–2 cm long, usually somewhat asymmetrical. Flowers 1.3–1½ mm in diam.

*T. obliqua* CRAIB from Siam is also closely related and scarcely specifically distinct from *T. triptera*.

4. *Terminalia polyantha* PRESL, Abh. Kön. Böhm. Ges. Wiss. V, 6 (1851) 574; MERR. Philip. J. Sc. C. Bot. 4 (1909) 646; EN. Philip. 3 (1923) 152.—*Gnidia oppositifolia* BLANCO, Fl. Filip. (1837) 299, non LINNÉ (1753).—*T. parviflora* PRESL, L.c.; GAGNEP. Fl. Gén. I.-C. 2 (1920) 754.—*Gnidia? philippinensis* MEISN. in DC. Prod. 14 (1857) 592.—*T. montalbanica* ELM. ex MERR. En. Philip. 3 (1923) 153, *nom. nud.*

Small tree. Young branchlets slender, at first pubescent, soon glabrescent. Leaves alternate or subopposite, chartaceous or papyraceous, sometimes tomentose when very young, usually sparsely pubescent or glabrous, sometimes tomentose on the midrib and principal nerves beneath, minutely verruculose above, rather obscurely pellucid-punctate, ovate, ovate-elliptic, elliptic or suborbicular, 3–8 by 1½–5 cm, usually somewhat acuminate and acute at the apex, cuneate to rounded at the base; nerves 6–8 pairs; petiole tomentose or pubescent, 5–10 mm. Flowers sessile, probably all ♂, in terminal and axillary panicles 3–10 cm long; rachides densely patent or appressed pubescent. Bracts

minute, caducous. Lower receptacle (ovary) viscid, glabrous, 1–2 mm long; upper receptacle cupuliform glabrous or nearly glabrous outside, pubescent inside, 1–1½ by 1½–2 mm. Calyx-lobes very short, pubescent on the margins. Filaments glabrous 3 mm; anthers 0.4–0.5 mm long. Disk pilose. Style glabrous, 3 mm. Fruit usually glabrous, generally 4-winged (rarely 2-, 3- or 5-winged), elliptical or suborbicular in outline, 8–15 by 7–12 mm (incl. wings).

Distr. Indo-China, in *Malaysia*: Philippines (Luzon, Mindoro). Fig. 10.

Ecol. A small tree of dry thickets and secondary forests at low and medium altitudes.

Wood anat. REYES, Commonw. Philip. Dept. Agr. Techn. Bull. 7 (1938) 367. Brief comments.

Uses. Wood employed for general house construction and for parts protected from the weather. Relatively rare (REYES l.c.).

Vern. *Anagap*, Tag., Sbl., *bangles*, Ilk.

Notes. *T. montalbanica* was a manuscript name distributed with ELMER 17420 from Montalban, Luzon. It has rather larger flowers than typical *T. polyantha* and a pubescent upper receptacle. There is only the single gathering cited.

5. *Terminalia citrina* (GAERTN.) ROXB. ex FLEM. in As. Res. 11 (1810) 183; KURZ, For. Fl. Burm. 1 (1877) 456; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 446; KING, J. As. Soc. Beng. 66, 2 (1897) 328; RIDL. Fl. Mal. Pen. 1 (1922) 704; CRAIB, Fl. Siam. En. 1 (1931) 602; BURK. Dict. (1935) 2140.—*Myrobalanus citrina* GAERTN. Fruct. 2 (1791) 91, t. 97, fig. n-s.—*T. chebula* (non RETZ.) BL. Bijdr. (1825) 643.—*Bucida comintana* BLANCO, Fl. Filip. (1837) 856.—*T. chebula* (non WILLD.) MIQ. Fl. Ind. Bat. 1, 1 (1855) 601; FERN.-VILL. Novis. App. (1880) 80.—*Embryogonia arborea* T. & B. in MIQ. J. Bot. Néerl. 1 (1861) 365; MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868–69) 115.—*Combretum arboreum* MIQ. L.c.—*T. citrina* var. *malayana* CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 447; KING, J. As. Soc. Beng. 66, 2 (1897) 447; RIDL. Fl. Mal. Pen. 1 (1922) 704.—*T. teysmannii* K. & V. Bijdr. Booms. 9 (1903) 20.—*T. arborea* K. & V. Bijdr. Booms. 9 (1903) 22; BACK. Schoolfl. Jav. (1911) 488; KOORD. Atl. Baumart. Jav. (1913) 72; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 24; HEYNE, Nutt. Pl. N.I. (1927) 1174; BURK. Dict. (1935) 2135; MEEUSE in BACK. Fl. Jav. em. ed. 4, fam. 101 (1944) 7.—*T. multiflora* MERR. Govt Lab. Publ. Philip. 27 (1904) 34.—*T. comintana* MERR. Philip. J. Sc. C. Bot. 4 (1909) 300; EN. Born. (1921) 423; EN. Philip. 3 (1923) 150; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 26.—*T. curtisii* RIDL. Kew Bull. (1931) 449.—Fig. 14.

Tree 20–30 m by about 70 cm. Young branchlets rufous-pubescent or rufous-villous (especially in seedlings), glabrescent or retaining their indumentum for a considerable time. Leaves papyraceous or chartaceous, opposite, subopposite or alternate, rufous-sericeous or rufous-pubescent to almost glabrous, sometimes pellucid-punctate, elliptic, narrowly elliptic or oblong-elliptic, 3–14 by 1.8–

6½ cm, usually acutely acuminate at the apex and rounded or broadly cuneate at the base; nerves 9–12 pairs usually rather closely spaced; domatia absent or inconspicuous; petiole appressed-pubescent or glabrous, 5–20 mm, 2 glands often present at or near the apex. *Flowers* sessile, yellow, all ♂, in terminal panicles; rhachides rufous-tomentose or pubescent. Bracts filiform, 2 mm long, very caducous. *Lower receptacle* (ovary) 1–1½ mm long, sericeous or shiny and almost glabrous; upper receptacle shallow-cupuliform, ½ by 2 mm, nearly glabrous. Filaments glabrous, 2½–3 mm; anthers 0.3 mm long. Disk barbate. Style glabrous 1½–2½ mm long. *Fruit* ellipsoid to subglobose, 5-angled, glabrous, 20–30 by 8–20 mm (when dried), endocarp shaped like a 5-pointed star in cross-section.

Distr. India, Burma, Indo-China, Siam throughout *Malaysia*, New Guinea possibly excepted. Fig. 10.

Ecol. Forests at low and medium altitudes, in the Malay Peninsula and the Philippines often along the seashore, often planted inland.

Wood anat. (*T. teysmannii* K. & Val.) MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 377; [*T. comintana* (Blanco) Merr.] REYES, Commonw. Philip. Dept Agr. Techn. Bull. 7 (1938) 369.

Uses. The wood is used for door-posts, beams and planks, boats and masts. In Indo-China beautiful furniture is said to be made from it. Tannin is extracted from the fruits and the bark gives a blue dye. The fruits are similar to and often mistaken for the commercial myrobalans (*T. chebula* RETZ.).

Vern. Malay Peninsula: *Antoi*, *antoi puteh*, *bēlang rimau*, *bēlawan*, *kayu rajah*, *galumit*, *blabab*, *J*, *djèrèt*, *tèngèh tjaäh*, *S*, *mērtaki*, *pēlawai*, *rēntaki*, Palembang; Philippines: *apunga*, *bangias*, *hinabuad*, *hinabuan*, *hinabusi*, *lakanab*, *maghubo*, *nanghubo*, *paghubo*, *palanag*, *rubian*, *saplungan*, Tag., *agaru*, *magtalopoi*, Pang., *bangles*, *lasilak*, *llk.*, *bingas*, *Sbl.*, *bongas*, *bungas*, *S.L.Bis.*, *bunglas*, *P. Bis.*, *bungras*, *Bik.*, *lasila*, *lasilak*, *lasilan*, *lasilat*, *Ibn.*, *luno-luno*, *Bag.*, *lununu*, *C.Bis.*, *malatagum*, *Sulu*, *maupat*, *Tagb.*, *tangisan*, *Pamp.*, *yunu-yunu*, *Mbo*.

Notes. I have treated this as a widespread variable species for there are numerous intermediates between the small-leaved, small-fruited Philippine specimens (*T. comintana*) and the large-leaved, larger-fruited specimens from Sikkim and Bengal.

BRASS & VERSTEEGH 14019 (A, BM), a sterile specimen from Bernhard Camp (Idenburg River in Netherlands New Guinea) may be this species. Otherwise there is no record from New Guinea.

This is a very *Combretum*-like species of *Terminalia* and if the records from the Malay Peninsula (BURK. *Lc.* 2140–2141) are correct it is sometimes a sprawler or semi-climber.

#### 6. *Terminalia creaghii* RIDL. Kew Bull. (1934) 493.

Tree or (?) climber. Young branchlets minutely, densely pubescent and viscid. *Leaves* subcoriaceous opposite and decussate, shining, glabrous,

\*narrowly elliptic or elliptic-oblong, 6–14 by 2½–6 cm, acuminate at the apex, cuneate or somewhat rounded at the base; nerves 5–8 pairs; domatia absent or inconspicuous; numerous conspicuous parallel tertiary veins on the lower surface; petiole glabrous, viscid, 6–8 mm. *Flowers* sessile in terminal panicles, rhachides pubescent. Bracts pubescent, 1½ mm long. *Lower receptacle* (ovary) glabrous, viscid 1½ mm long; upper receptacle cupuliform 1½ by 3½ mm, glabrous. *Calyx*-lobes scarcely developed. Stamens 10–12; filaments glabrous, 3–4 mm; anthers 0.8 mm long. Disk pilose. Style glabrous, 5 mm. *Fruit* unknown.

Distr. *Malaysia*: NE. Borneo. Fig. 10.

Note. This species, described from a single collection made by Governor Creagh in British North Borneo, is a puzzle. In general appearance the plant is more like a *Combretum* than a *Terminalia* but I cannot identify it with any known species of the former genus. There are certainly no petals but the flowers are abnormal (several have an extra number of stamens) and appear to have suffered from an insect attack. The leaves seem to be truly opposite as in *Combretum*. The ovary is quite inferior, 1-locular with usually 4 pendulous ovules so there is little doubt that the species is at least in the right family. Discovery of the fruit would show whether it is a true *Terminalia*, perhaps near *T. citrina* or an apetalous *Combretum*, near *C. acuminatum* or *C. borneense*. The absence of any trace of scales inclines me to think that the balance of evidence is for *Terminalia*.

7. *Terminalia calamansanai* (BLANCO) ROLFE, J. Linn. Soc. Bot. 21 (1884) 310; MERR. Philip. J. Sc. C. Bot. 4 (1909) 646; EN. Philip. 3 (1923) 149.—*Gimbernatea calamansanai* BLANCO, Fl. Filip. ed. 2 (1845) 266.—*Pentaptera pyrifolia* PRESL, Abh. Kön. Böhm. Ges. Wiss. 6 (1851) 575.—*T. pyrifolia* KURZ, Prelim. Rep. For. Veg. Pegu App. A (1875) 59; For. Fl. Burm. 1 (1877) 457; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 448; CRAIB, Fl. Siam. En. 1 (1931) 607; CORNER, Wayside Trees (1940) 194, t. 46.—*T. papilio* HANCE, J. Bot. 15 (1877) 333.—*T. bialata* (non KURZ) FERN.-VILL. Novis. App. Fl. Philip. (1880) 80 *pro parte* quod syn. cit. '*Gimbernatea Calamansanay*'.—*Myrobalanus pyrifolia* KUNTZE, Rev. Gen. Pl. (1891) 237.—*T. bialata* (non STEUD.) KING, J. As. Soc. Beng. 66, 2 (1897) 332; RIDL. Fl. Mal. Pen. 1 (1922) 705; BURK. Dict. (1935) 2137.—*T. mollis* MERR. Govt Lab. Publ. (1913) 17 (1904) 34 *non T. mollis* LAWS. (1871) *nec* ROLFE (1885).—*T. blancoi* MERR. Philip. J. Sc. C. Bot. 4 (1909) 645.—*T. calamansanai* var. *acuminata* MERR. *tom. cit.* (1909) 646 *et* var. *platypteris* MERR. *l.c.*—*T. latilata* C. T. WHITE, J. Arn. Arb. 10 (1929) 249.—Fig. 11.

A medium-sized or large, deciduous tree, 8–30 m or more. Young branchlets tomentellous, appressed-pubescent or nearly glabrous. *Leaves* spirally arranged and somewhat crowded towards the ends of the twigs, subcoriaceous or chartaceous, usually subtomentose or pubescent, especially on the lower surface when young, frequently becoming glabrous when mature but often retain-



Fig. 11. *Terminalia calamansanai* (BLANCO) ROLFE. Six trees by the road from Kodiang to Changlun, Kedah (CORNER). Courtesy Government Printer Singapore.

ing some pubescence beneath, usually somewhat shiny above, narrowly to broadly elliptic or occasionally obovate, 9–20 by 3–9 cm, usually acuminate rarely rounded at the apex, cuneate at the base, usually minutely verruculose on both surfaces, sometimes manifestly pellucid-punctate but usually only very obscurely so; nerves 4–7 pairs, rather widely spaced, reticulation clearly visible and sometimes rather prominent below; petiole tomentose, appressed-pubescent or glabrous, 1–4 cm, often with 2 glands varying in position from the middle to near the apex. *Flowers* cream or greenish-yellow, buds globular, protogynous, sessile in axillary spikes 6–20 cm long; rachis tomentose or tomentellous. Bracts  $1\frac{1}{2}$ –2 mm long, soon deciduous. *Lower receptacle* (ovary) 1–2 mm long, tomentose or sericeous; upper receptacle shallow-cupuliform 1 by  $2\frac{1}{2}$  mm, sericeous. *Calyx*-lobes deltoid, 1 mm long, tomentose outside and rather less densely so within. Filaments glabrous, 2– $2\frac{1}{2}$  mm; anthers  $\frac{1}{2}$  mm long. Disk, barbate. Style glabrous,  $1\frac{1}{2}$  mm. *Fruit* with 2 broad wings, very variable in size and shape, overall dimensions 1–3 by 2–10 cm, fruit-body trigonal, pubescent, velutinous or tomentose, wings pubescent 1–2 by 2–4 cm.

*Distr.* Burma, Indo-China, Siam, in *Malaysia*: N. Malay Peninsula (from Alor Star northwards and in Langkawi Islands), Borneo? (sterile material only), Philippines, SW. Celebes (Pangkajene), and New Guinea (Papua). Fig. 12.

*Ecol.* A medium-sized tree (described as a tall tree in Papua) shedding its leaves towards the end of the year and growing on limestone cliffs (Langkawi Isl.), in lowland forest and by roads and ricefields in Kedah and Perlis where it is one of the commonest trees. *Fl.* Aug.–Dec. in the rainy season, *fr.* Dec.–April during the dry season, easily recognizable from its rather small-leaved, flat-topped crown, sparsely decked with the bright yellow withered leaves (CORNER, *l.c.*). In the Philippines it is also abundant in primary forests. Apparently a species confined to areas subject to a dry season.

*Wood anat.* (*T. pyrifolia* KURZ) PEARSON & BROWN, *Comm. Timb.* 1 (1932) 528; REYES, *Commonw. Philip. Dept Agr. Techn. Bull.* 7 (1938) 367.

*Uses.* The wood is employed for foundation piles; seldom sawn into lumber or used for construction as it is not durable (REYES *l.c.*).

*Vern.* Malay Peninsula: *Méntalan batu*, *médang mérapoh*, *batalong*, M.; Philippines: *kalamansanai* (Tag. standard), *anarep*, *bagabo*, *pangalusiten*, *saket*, *Ilk.*, *bangkalauan*, *bunlos*, *malakalumpit*, *sakat*, *kalamansakat*, *subo-subo*, Tag., *bangkalauag*, Bis., *bisal*, *busili*, Pang., *burauis*, Kuy., *dikang*, Pamp., *kabangasbangas*, Bag., *kalamansali*, Sbl., *langkog*, *yankug*, Mbo., *langtug*, *lumanog saplid*, C. Bis., *magtalisai*, P. Bis., *saget*, Ig., *salisai*, Lan.

*Notes.* The Asiatic *Terminalias* with two laterally extended wings to the fruit have caused no little difficulty in classification, as will be seen from the complicated synonymy. I found no clear-

cut distinctions in the shape of the fruit and decided finally to recognize only two Malaysian species: a 'northern' species (*T. calamansanai*) with pubescent fruits, extending from Burma and Indo-China down to the North of the Malay Peninsula and through the more northerly islands as far as Papua; and a 'southern' species (*T. subspathulata*) with glabrous fruits and glaucous leaves extending from the Malay Peninsula to Sumatra, Java and Borneo. Both species may occur in Borneo.

**8. *Terminalia subspathulata* KING, J. As. Soc. Beng. 66, 2 (1897) 332; RIDL. Fl. Mal. Pen. 1 (1922) 705; BURK. Dict. (1935) 2141; CORNER, Wayside Trees (1940) 195, fig. 50.—*T. bialata* (non KURZ) K. & V. Bijdr. Booms. 9 (1903) 28; KOORD. Atl. Baumart. 1 (1913) t. 73; BACK. Schoofl. Java (1911) 490; KOORD. Exk. Fl. 2 (1912) 671 (*err. 'alata'*); MEEUSE in BACK. Fl. Jav. (em. ed.) 4, fam. 101 (1944) 8.**

A large tree up to 45 m, with tall spreading branches. Young branchlets at first rufous-appressed-pubescent soon becoming glabrous. *Leaves* spirally arranged and somewhat crowded towards the ends of the twigs, coriaceous or subcoriaceous, glossy green above, glaucous underneath, glabrous, oblanceolate or subspathulate, 4–14 by  $1\frac{1}{2}$ –5 cm, rounded and shortly acuminate, acute or obtuse at the apex, narrowly cuneate at the base; nerves 8–10 pairs, reticulation rather prominent; petiole glabrous 2– $3\frac{1}{2}$  (–5) cm, glands absent or inconspicuous. *Flowers* greenish or yellow, buds globular, sessile, in axillary spikes 6–20 cm long, rachis densely rufous-appressed-pubescent. Bracts absent or very early caducous. *Lower receptacle* (ovary) 2 mm long, rufo-sericeous; upper receptacle shallow-cupuliform, sericeous, 1 by 2 mm. *Calyx*-lobes deltoid 0.8 mm long, densely appressed-pubescent. Filaments glabrous,  $2\frac{1}{2}$  mm; anthers 0.4 mm long. Disk barbate. Style 3 mm, pilosulose. *Fruit* broadly 2-winged, light yellow, pubescent when very young but soon becoming glabrous, overall dimensions 2–3.3 by  $3\frac{1}{2}$ – $5\frac{1}{2}$  cm, wings usually confluent at apex and base so that the fruit is circumalate.

*Distr. Malaysia*: Sumatra, Malay Peninsula

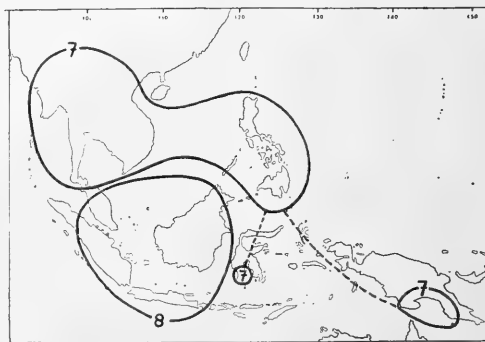


Fig. 12 Distribution of *Terminalia* series B:  
7. *calamansanai*, 8. *subspathulata*.

(scarce, from Perak southward), Java, and Borneo (Balikpapan, Pleihari, Sarawak). Fig. 12.  
Ecol. Up to 1350 m in Java.

Wood anat. (*T. bialata*) MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 377.

Uses. Quality of timber unknown.

Vern. *Jélawai*, *pělawai*, *médang salak*, Mal. Pen.

**9. *Terminalia kjellbergii* EXELL, Blumea 7 (1953) 322.**

Tree, 15 m. Young branchlets rather thick, 4–5-angled near the apex, at first fulvous-sericeous-tomentose but very soon becoming glabrous, growth sympodial. *Leaves* coriaceous, spirally crowded at the ends of the branchlets, sparsely sericeous-pilose when young, soon becoming shiny and glabrous, minutely verruculose above, narrowly obovate-spathulate, obovate-elliptic or narrowly elliptic, 5–20 by 2–7½ cm rounded or obtuse at the apex, rounded or subcordate and 2-glandular at the base; nerves 11–12 pairs; petiole thick, 3–5 mm, at first fulvous-tomentose soon glabrescent. *Flowers* sessile in axillary spikes up to 17 cm long; rhachis rather stout, minutely appressed-pubescent or almost glabrous. Bracts filiform, 1½ mm long. *Lower receptacle* (ovary) fulvo-sericeous 3½–4 mm long; upper receptacle cupuliform, 3–3½ by 5–5½ mm, outside viscid almost glabrous, inside sericeous-pilose with glabrous ovate-acuminate *calyx*-lobes about 3 mm long. Filaments glabrous 12–13 mm; anthers 1 mm long. Disk almost glabrous. Style glabrous, 11 mm. *Fruit* ovate in outline, glabrous, 2½ by 1.7 cm, 2-winged, wings 5 mm broad.

Distr. *Malaysia*: Central Celebes (Malili, Towuti Lake).

Ecol. Medium-sized tree in swamps, 300–400 m.

**10. *Terminalia surigaensis* MERR. Philip. J. Sc. 17 (1921) 295; En. Philip. 3 (1923) 153.**

Tree. Young branchlets very thick, at first sparsely appressed-pubescent soon glabrous. *Leaves* subcoriaceous, spirally arranged, crowded at the end of the branchlets, glabrous, narrowly spatulate or narrowly obovate-elliptic, 10–13 by 3½–4½ cm, rounded at the apex, cuneate at the base, somewhat shiny above; petiole 5–7 mm, with 2 conspicuous glands at or near the apex. *Flowers* sessile in axillary spikes about 10 cm long; rhachis glabrous. Bracts (not seen) caducous. *Lower receptacle* (ovary) 4–5 mm long, glabrous; upper receptacle cupuliform glabrous 3–4 by 4–6 mm. *Calyx*-lobes glabrous, deltoid, 2 mm long. Filaments glabrous, 10–12 mm long; anthers 0.8 mm long. Disk glabrous or nearly glabrous. Style glabrous, 11–12 mm. *Fruit* glabrous, suborbicular in outline, 1.6–2 cm in diameter, circumscissile, usually emarginate at the base and apex.

Distr. *Malaysia*: Philippines (Mindanao).

Ecol. Along streams at low altitudes.

**11. *Terminalia darlingii* MERR. Philip. J. Sc. C. Bot. 5 (1910) 202; En. Philip. 3 (1923) 151.**

Tree. Young branchlets very thick, sparsely pubescent or glabrous. *Leaves* subcoriaceous or

chartaceous, spirally arranged in dense clusters at the ends of the branchlets, subsessile or shortly petiolate, shining, glabrous or appressed-pubescent mainly on the midrib and principal veins and sometimes on the lamina, minutely verruculose above, obscurely pellucid-punctate, spatulate, 15–26 by 6–9½ cm, rounded at the apex, narrowly cuneate at the base and decurrent into the short thick petiole; petiole 5–7 mm, or sometimes scarcely developed, with two large subopposite glands at the apex or at the base of the lamina. *Flowers* large for the genus in axillary spikes c. 12 cm long; rhachis appressed-pubescent. Bracts narrowly elliptic, 10–15 mm long, fulvo-sericeous, persistent. *Lower receptacle* (ovary) c. 2 mm long, fulvo-sericeous; upper receptacle cupuliform, about 5 by 7 mm, nearly glabrous. *Calyx*-lobes deltoid about 2 mm long. Filaments glabrous, 15 mm; anthers 0.3–0.4 mm long. Disk sparsely pilose or nearly glabrous. Style 17 mm, glabrous. *Fruit* circumscissile suborbicular or broadly obovate in outline, 1.7–3 by 1.7–2½ cm, tomentellous or appressed-pubescent.

Distr. *Malaysia*: Philippines (Luzon, Samar). Fig. 13.

Ecol. Primary forests at low altitudes.

Wood anat. REYES, Commonw. Philip. Dept. Agr. Techn. Bull. 7 (1938) 367. Brief comments.

Uses. The wood is used for house posts, beams, joists, and general framing work. Not plentiful (*REYES l.c.*).

Vern. *Pagat-págat*, Neg.

Note. This differs from *T. surigaensis* in the fulvo-sericeous lower receptacle (ovary), rhachis and fruit.

**12. *Terminalia slooteniana* EXELL, Blumea 7 (1953) 323.**

Tree, 25 m. Young branchlets thick, glabrous, sympodial. *Leaves* coriaceous spirally arranged and crowded at the ends of the branchlets, glabrous, shiny above, minutely verruculose above and below, spatulate, oblanceolate or narrowly obovate-elliptic, 10–20 by 4–8 cm, rounded at the apex, narrowly cuneate at the base and decurrent into the petiole; nerves 9–12 pairs; petiole glabrous, 1–2 cm, with two glands (sometimes inconspicuous).

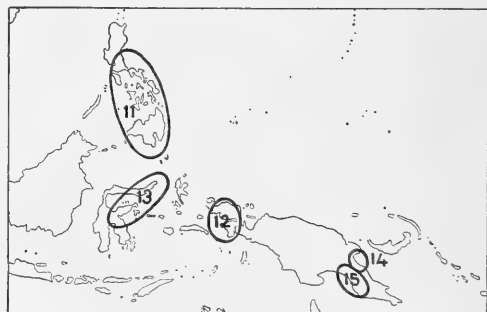


Fig. 13. Distribution of *Terminalia* series C(a): 11. *darlingii*, 12. *slooteniana*, 13. *supitiana*, 14. *clomensae*, 15. *steenisiana*.



ous) at or near the apex. *Flowers* not known. *Fruit* glabrous, suborbicular to broadly elliptic in outline,  $7\frac{1}{2}$  by 6 by c. 3 cm, circumalate with a stiff narrow wing 2–4 mm broad, closely resembling a small tortoise in shape.

Distr. *Malaysia*: West New Guinea (Rauna and Fakfak). Fig. 13.

Ecol. Large tree in primary forest at low altitudes.

Vern. *Gufasa catu, sawar*.

Notes. Named after Dr D. F. VAN SLOOTEN, who first recognized it as new, and in commemoration of his excellent work on the *Combretaceae* of the East Indies.

**13. *Terminalia supitiana* KOORD.** Minah. (1898) 454, 623; Fl. N.O. Celebes Suppl. 2 (1922) f. 99; Suppl. 3 (1922) 48; SLOOT. Bijdr. Combret. (1919) 23; Bull. Jard. Bot. Btzg III, 6 (1924) 39.

Large tree 20–50 m. Young branchlets sympodial, glabrous or nearly glabrous. *Leaves* subcoriaceous, spirally arranged and rather crowded at the ends of the branchlets, glabrous or sparsely minutely appressed-pubescent, rather inconspicuously minutely verruculose above, narrowly elliptic, 3–15 by 1.2–5 cm, blunt or pointed at the apex, cuneate at the base and decurrent into the petiole, nerves 9–11 pairs; petiole 5–10 mm, glabrous, with 2 glands (sometimes inconspicuous) near the apex. *Flowers* white, sessile, in short axillary spikes, 3–5 cm long; rhachis glabrous. Bracts filiform, 1 mm. *Lower receptacle* (ovary) glabrous, 5 mm long, narrowed at base and apex; upper receptacle shallow-cupuliform, glabrous, 1 by 2 mm. *Calyx*-lobes glabrous, broadly ovate, 1 mm long. Filaments glabrous,  $2\frac{1}{2}$ –3 mm; anthers  $\frac{1}{2}$  mm long. Disk densely pilose. Style glabrous, 2 mm. *Fruit* glabrous, elliptical in outline 4–5 $\frac{1}{2}$  by 2–2 $\frac{1}{2}$  cm, 2-winged, wings confluent at base and apex (circumalate), 7–10 mm broad.

Distr. *Malaysia*: North and Central Celebes (Menado and Malili). Fig. 13.

Ecol. Primary forests, 0–500 m.

Vern. *Anjuring, kanjuruang cata, tēluse*.

**14. *Terminalia clemensae* EXELL,** Blumea 7 (1953) 324.—Fig. 14.

Tree. *Leaves* coriaceous, shiny above, glabrous, elliptic, 20 by 8 cm, rounded or shortly acuminate at the apex, cuneate at the base; nerves 12–14 pairs; petiole glabrous,  $1\frac{1}{2}$ –2 cm. *Flowers* not known. *Fruit* very woody, probably appressed-pubescent when young (traces of indumentum remain) almost glabrous or glabrous when mature, compressed ovoid-ellipsoid or compressed ellipsoid, 6–7 by 3–4 by  $1\frac{1}{2}$ –1.8 cm, narrowly circumalate, wing rigid, 4 mm broad, showing in cross-section an irregular mass of sclerenchyma enclosing a few small scattered air-chambers.

Distr. *Malaysia*: NE. New Guinea (Morobe). Fig. 13.

Ecol. In forests, 650–950 m.

Note. Nothing more is known of this species,

which was collected from a fallen branch. Judging from the fruits it appears to be a very distinct species.

**15. *Terminalia steenisiana* EXELL,** Blumea 7 (1953) 327.—*T. cf. 'foveolata'* EXELL, Brittonia 2 (1936) 138.—Fig. 14.

Tree 10–15 m. Bark grey-brown. Wood hard, brown. Young branchlets at first appressed-rufopubescent, soon becoming glabrous, sympodial in growth. *Leaves* subcoriaceous, crowded at the slightly thickened apices of the branchlets, shiny and glabrous above, only very obscurely verruculose, opaque, elliptic, obovate-elliptic, obovate or oblanceolate, 8–13 by  $2\frac{1}{2}$ –6 cm, rounded, obtuse or shortly acuminate at the apex, cuneate at the base; nerves 6–10 pairs, domatia rather inconspicuous, occasionally with a few hairs; petiole glabrous in mature leaves, 1–2 cm. *Flowers* white, in axillary spikes 6–8 cm long; rhachis glabrous when mature. Bracts filiform, 1 mm, glabrous, early caducous. *Lower receptacle* (ovary) glabrous,  $2\frac{1}{2}$  mm long; upper receptacle glabrous shallow-cupuliform, 1 by 3 mm. *Calyx*-lobes deltoid,  $1\frac{1}{2}$  mm long. Filaments glabrous,  $2\frac{1}{2}$  mm; anthers  $\frac{1}{2}$  mm long. Disk densely pilose. *Fruit* red when ripe, glabrous, when dried compressed-ellipsoid,  $2\frac{1}{2}$ –3 $\frac{1}{2}$  by  $1\frac{1}{2}$ –2.6 by 0.8–1.2 cm, longitudinally circumalate with a rigid wing 2–3 mm broad, sometimes with 2–3 additional longitudinal ridges, sometimes flat on one face and convex on the other, showing in cross-section a rather thick, irregularly elliptical band of sclerenchymatous tissue and little or no alveolar tissue.

Distr. *Malaysia*: New Guinea (Papua: Nakeo District and Kanosia). Fig. 13.

Ecol. A common tree in lowland rain-forest.

Note. The fruit is said to be fleshy when ripe.

**16. *Terminalia oreadam* DIELS,** Bot. Jahrb. 57 (1922) 429.—Fig. 14.

Large tree, up to 40–50 m, buttressed to 2 m. Bark pale brown, wood pale yellow. Young branchlets fulvous-sericeous, later glabrescent. *Leaves* subcoriaceous, spirally arranged along the branchlets, minutely appressed-pubescent, later glabrescent, broadly to narrowly elliptic, 3–9 by 1–4 cm, slightly acuminate or blunt at the apex, cuneate at the base; nerves 5–8 pairs with glabrous domatia in their axils; petiole at first appressed-pubescent eventually glabrescent, 5–12 mm. *Flowers* (only immature ones seen) sessile, ellipsoid in bud, in axillary spikes c. 5 cm long; rhachis fulvous-sericeous. Bracts hairy, filiform,  $2\frac{1}{2}$  mm, soon caducous. *Lower receptacle* (ovary)  $1\frac{1}{2}$  mm long, fulvous-sericeous, upper receptacle fulvous-sericeous, cupuliform, 1 by  $1\frac{1}{2}$  mm. *Calyx*-lobes triangular, c. 1 mm long. *Fruit* very sclerenchymatous, with a few scattered air-spaces, sericeous when young, glabrescent, flattened-ellipsoid,  $3\frac{1}{2}$  by  $1\frac{1}{2}$ –2 cm, narrowly circumalate, wing c. 1 mm broad, sometimes with 2 additional ridges near the apex.

Distr. *Malaysia*: East New Guinea. Fig. 15.

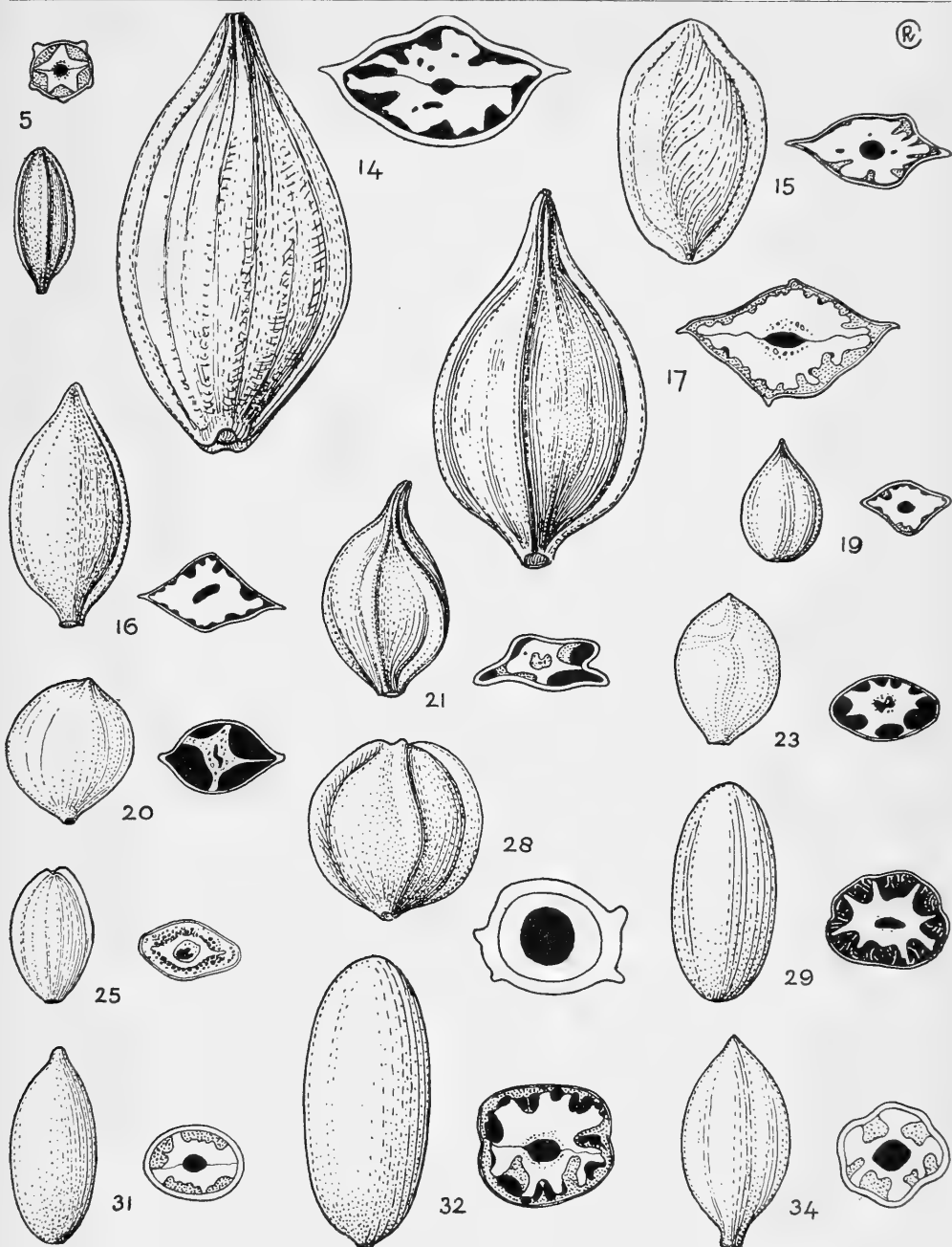


Fig. 14. Fruits of *Terminalia* numbered to correspond with the species in the text; a fruit of each species and its cross-section; all from herbarium material; loculus and hollows black, sclerenchyma white, alveolar tissue dotted; nat. size.—5. *T. citrina* (BARROS FB 24842), 14. *T. clemensae* (CLEMENS 3087), 15. *T. steenisiana* (BRASS 3759), 16. *T. oreadam* (SMITH NGF 1039), 17. *T. sepicana* (NGF 3179), 19. *T. microcarpa* (MANEJA FB 23982), 20. *T. complanata* (BRASS 6433), 21. *T. hypargyrea* (BRASS 8551), 23. *T. longespicata* (LEDERMANN 8068), 25. *T. samoensis* (BRASS 3095), 28. *T. bellirica* (KOORDERS 30944), 29. *T. macadamii* (MCADAM 8), 31. *T. kangeanensis* (BACKER 27306), 32. *T. celebica* (WATURANDANG 26), 34. *T. soembawana* (DOMMERS s.n.).

Ecol. Montane and submontane forest, 1200–2000 m.

Vern. *Marori, suba, tuba*.

**17. *Terminalia sepicana*** DIELS, Bot. Jahrb. 57 (1922) 429; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 40.—Fig. 14.

Tree up to 50 m, buttressed to 2½ m, with spreading crown. Bark brown or grey, inner bark pink or brownish-red, sapwood straw-coloured, inner wood light brown. Young branchlets at first densely appressed-pubescent or appressed-pilose later glabrescent. *Leaves* spirally arranged along the branchlets, chartaceous or subcoriaceous, at first densely appressed-pubescent, later glabrescent, obscurely pellucid-punctate when young, opaque when older, elliptic, obovate-elliptic or oblong-elliptic, 6–15 by 3–7½ cm, blunt or rounded, sometimes shortly acuminate or apiculate at the apex, cuneate at the base; nerves 7–9 pairs; domatia present, sometimes hairy; petiole at first tomentellous or appressed-pubescent, later glabrescent, 8–14 mm. *Flowers* sessile in axillary spikes up to 4 cm long; rhachis densely sericeous. Bracts hairy, filiform, 1 mm, early caducous. *Lower receptacle* (ovary) sericeous, 1 mm long; upper receptacle scarcely developed. *Calyx*-lobes triangular, 0.8 mm long. Filaments glabrous, 1½–2 mm; anthers 0.3 mm long. Disk barbate. Style glabrous, 1½ mm. *Fruit* reddish-purple, densely appressed-pubescent when young and retaining at least some indumentum when old, compressed ellipsoid, pointed at the apex, circumscissile with a narrow wing or ridge 1–2 mm broad and 2 or 3 accessory ridges also developed, especially towards the apex, 4–5 by 2½–3 by 1½–2 cm when dried; endocarp hard and very sclerenchymatous in cross-section, air-spaces poorly developed in a ring round the locus.

Distr. *Malaysia*: NE. New Guinea (Sepik and Morobe District) and New Britain. Fig. 15.

Ecol. Rain-forest at low and medium altitudes.

Uses. The wood is said to be very soft. The fruit is said to be edible and to exude a red dye.

**18. *Terminalia rubiginosa*** K. SCHUM. in K. SCHUM. & HOLLR. Fl. Kais. Wilh. Land (1889) 84; K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 466; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 30, *pro parte excl.* FORBES 636.

Large tree up to 35 m high. Young branchlets rufous-tomentose or rufous-appressed-pubescent, becoming glabrous, somewhat sympodial in growth but not always markedly so. *Leaves* spirally arranged and crowded at the apices of the branchlets, rufous- or fulvous-tomentellous when young and remaining so on the nerves below and sometimes also on both surfaces of the leaf-blade, sometimes rather inconspicuously minutely verruculose on the upper surface, obovate-obovate-elliptic or narrowly obovate-elliptic, 5–10 by 2½–5½ cm, usually rounded at the apex and cuneate at the base; nerves 9–13 pairs, rather closely spaced; petiole rufous or fulvous-tomentose 4–13 mm. *Flowers* yellow, sessile, buds

globose, in axillary spikes 4–9 cm long; rhachis rufous-tomentose. Bracts filiform fulvous-pubescent, 1½–2½ mm. *Lower receptacle* (ovary) rufous-tomentose, 1–2 mm long; upper receptacle densely pubescent, shallow-cupuliform ½ by 1 mm. *Calyx*-lobes ovate, 1 mm long. Filaments glabrous 2½ mm; anthers 0.3–½ mm long. Disk pilose. Style glabrous 3–4 mm long. *Fruit* densely appressed-pubescent somewhat glabrescent when old, broadly elliptic in outline, 5 by 3½ cm, laterally compressed, surrounded by a thick narrow wing 2 mm broad, with 3 additional ridges developed especially towards the apex where the fruit appears sub-5-winged.

Distr. *Malaysia*: Moluccas (N. Halmahera: Tobelo, and Aru Islands), New Guinea. Fig. 15.

Ecol. Fairly common in primary forest at low altitudes.

Vern. *Karou, mambang*.

**19. *Terminalia microcarpa*** DECNE. Nouv. Ann. Mus. Par. 3 (1834) 457; Herb. Timor. Descr. (1835) 129; SPAN. Linnaea 15 (1841) 203; MIQ. Fl. Ind. Bat. 1, 1 (1855) 602; SLOOT. Bijdr. Combr. (1919) 17; Bull. Jard. Bot. Btzg III, 6 (1924) 20.—*T. intermedia* SPAN. in HOOK. Comp. Bot. Mag. 1 (1836) 347, *nom. nud.*; Linnaea 15 (1841) 203, *in syn.*, *non T. intermedia* BERT. & SPRENG. (1825).—*T. angustifolia* BLANCO, Fl. Filip. (1837) 377, *non T. angustifolia* JACQ. (1776).—*T. edulis* BLANCO, Fl. Filip. ed. 2 (1845) 265; MERR. Philip. J. Sc. C. Bot. 4 (1909) 643; En. Philip. 3 (1923) 151; W. H. BROWN, Minor Prod. Philip. For. 2 (1921) 354, fig. 71; SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 18; HEYNE, Nutt. Pl. N. I. (1927) 1177; BURK. Dict. (1935) 2141; MEEUSE in BACK. Fl. Jav. (em. ed.) 4, fam. 101 (1944) 7.—*Pentaptera mollis* PRESL, Abh. Kön. Böhm. Ges. Wiss. V, 6 (1850) 574.—*T. javanica* MIQ. Fl. Ind. Bat. 1, 1 (1855) 602; KOORD. & VAL. Bijdr. Booms. Jav. 9 (1903) 23; Atlas Baumart. (1913) t. 74; BACK. Schoolfl. Jav. (1911) 489; KOORD. Exk. Fl. Jav. 2 (1912) 671; SLOOT. Bijdr. Combr. (1919) 18.—*T. belerica* (*non* ROXB.) FERN.-VILL. Novis. App. (1880) 80.—*T. mollis* (PRESL) ROLFE, J. Bot. 23 (1885) 212, *non T. mollis* LAWS. (1871).—*Myrobalanus microcarpa* KUNTZE, Rev. Gen. Pl. (1891) 237.—*Myrobalanus javanica* KUNTZE, l.c.—*T. foveolata* WHITE & FRANCIS ex LANE-POOLE, For. Res. Papua & N. Guin. (1925) 123 (*sphalm. 'foveolata'*); Proc. R. Soc. Queensl. 38 (1927) 248, f. 12.—Fig. 14.

Tree 10–40 by 2 m. Young branchlets at first fulvous-sericeous soon glabrescent, usually not markedly sympodial. *Leaves* papyraceous or chartaceous spirally arranged along the branchlets usually not markedly crowded at the apices, at first densely sericeous-pilose some appressed hairs usually remaining on both surfaces in old age but sometimes becoming glabrous, minutely verruculose above and below, usually pellucid-punctate at time of flowering later becoming opaque, elliptic, oblong-elliptic, or broadly elliptic or sometimes very narrowly elliptic on sterile shoots, 6–15(–32) by 2–7(–11) cm, acuminate or

apiculate at the apex, cuneate at the base; nerves 7-13 pairs; domatia usually present but not hairy; two rather inconspicuous glands usually present near the base of the leaf-blade; petiole appressed-pubescent or appressed-pilose, sometime glabrescent, usually relatively long and slender,  $1\frac{1}{2}$ -3½ cm. *Flowers* sessile, in axillary spikes 6-12 cm long, rhachis fulvous-tomentose. Bracts hairy, filiform, 2-3 mm. *Lower receptacle* (ovary) densely sericeous,  $1\frac{1}{2}$ -2 mm long; upper receptacle very shallow, scarcely developed. *Calyx*-lobes pubescent, ovate-triangular,  $1-1\frac{1}{2}$  mm long. Filaments glabrous, 2 mm; anthers 0.3-0.4 mm long. Disk barbate. Style glabrous,  $1\frac{1}{2}$  mm. *Fruit* plum-like, smooth, dark red, fleshy, edible, drupaceous, somewhat acid, up to 27 by 15 mm, when dried appressed-pubescent, flattened-ellipsoid, 10-20(-25) by 6-12 mm, often verrucose, usually apiculate at the apex and narrowly (sometimes obscurely) circumalate, endocarp very sclerenchymatous.

*Distr. Malaysia*: throughout the area but apparently absent from the Malay Peninsula, perhaps in Sumatra (record based on sterile material only). Fig. 15.

*Ecol.* A usually tall tree common in both primary evergreen and in seasonal deciduous forests (e.g. teak-forest in Java), up to 800 m.

*Wood anat.* (*T. javanica* MIQ.) MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 374; (*T. edulis* BLANCO) REYES, Commonw. Philip. Dept Agr. Techn. Bull. 7 (1938) 371.

*Uses.* The fruits (fleshy pericarp) are edible and are also used in lotions for the eye and skin. The wood is light brown and not very durable when exposed to the weather or in contact with the ground. A durable wood for interior work. Used for furniture and cabinet making; a good wood for ship planking (REYES *l.c.* & p. 372).

*Vern.* *Djaha bēnti*, *gamprit*, *klumpit*, *klumpit*, *sēlumpit*, *J. klompēk*, Md, *kadju tandu*, *kalumpit*, Kangean, *kunjit-kunjit*, Bali, *lēka sēla*, *tawa im bolai*, *kanalo*, Minahassa; Philippines: *kalumpit*, standard, *alupi*, *kalurig*, *kalusit*, Ibn., *anagap*, *kalautit*, Ilk., *baho*, *baraus*, *kamaris*, Tagb., *bali-sayin*, basal, *dalinson*, *kalamai*, Tag., *bango*, Mbo., *gisit*, *basi*, Itn., *bisi*, *disi*, *kalaotit*, Gad., *buluang*,

Bis., *gayumayen*, Sbl., *kalomagon*, *kalumagon*, *kalumangog*, *kotmok*, Bik., *kalomaog*, *kalumanog*, *magtalisai*, *taya-táya*, P. Bis., *kalupi*, *kalupit*, Neg., *lumangog*, S. L. Bis.

*Notes.* From duplicates distributed from Paris there is little doubt that *T. microcarpa* is the oldest name for the well-known species usually known as *T. edulis* BLANCO.

**20. *Terminalia complanata* K. SCHUM.** in K. SCHUM. & HOLLR. Fl. Kais. Wilh. Land (1889) 83; K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 466.—Fig. 14.

Large buttressed tree with spreading crown, up to 50 m. Bark grey, yellow-brown or reddish-brown (according to different collectors), wood yellow. Young branchlets slender, at first rufous-sericeous, eventually glabrescent. *Leaves* chartaceous to subcoriaceous, spirally arranged, dispersed along the branchlets, at first rufous- or golden-appressed-pubescent, usually glabrescent, shiny above, minutely verruculose above and below, usually markedly pellucid-punctate, typically elliptic or narrowly elliptic, sometimes oblong-elliptic, rarely obovate, 5-10 by 2-4 cm, acuminate or shortly acuminate at the apex, cuneate at the base; nerves 9-12 pairs (occasionally more), rather prominent and somewhat closely spaced; petiole slender, at first appressed-pubescent, soon glabrescent,  $1-1\frac{1}{2}$  cm, usually with two glands near the centre or towards the apex. *Flowers* sessile, pale green, in lateral spikes 3-10 cm long; rhachis rufous- or fulvous-tomentose. Bracts hairy, filiform, recurved, 2 mm, soon caducous. *Lower receptacle* (ovary) sericeous,  $1\frac{1}{2}$  mm long; upper receptacle scarcely evident. *Calyx*-lobes triangular,  $1\frac{1}{2}$  mm long. Filaments very slender, glabrous,  $2\frac{1}{2}$ -3 mm; anthers 0.2 mm long. Disk barbate. Style glabrous, 3 mm. *Fruit* dull purple, suborbicular in outline and laterally compressed or broadly flattened-ellipsoid, sericeous at first and usually retaining some traces of indumentum, 1.8-2.2 by 1.4 by 1.7 cm, very narrowly circumalate, often apiculate at the apex, in cross-section showing a few radial plates of sclerenchyma separated by large air-spaces.

*Distr. Malaysia*: New Guinea, New Britain, and Solomon Islands (Guadalcanal). Fig. 15.

*Ecol.* In rain-forests up to 1400 m, sometimes dominant in riverine swamp-forest, fairly widespread in New Guinea.

*Uses.* The wood is said to be tough and fibrous and to contain a yellow dye.

*Vern.* *Naroongap*, Papua (Yalu), *doana*, Papua, *kwisik*, Sepik.

**21. *Terminalia hypargyrea* K. SCHUM. & LAUT.** Fl. Deut. Schutzgeb. Südsee (1901) 467; SLOOT. Bijdr. Combr. (1919) 20; Bull. Jard. Bot. Btzg III, 6 (1924) 24; DIELS, Bot. Jahrb. 57 (1922) 428.—Fig. 14.

Large spur-buttressed tree; wood pale yellow. Young branchlets silvery- or golden-reddish-sericeous, retaining some indumentum for a considerable time. *Leaves* chartaceous to coriaceous,

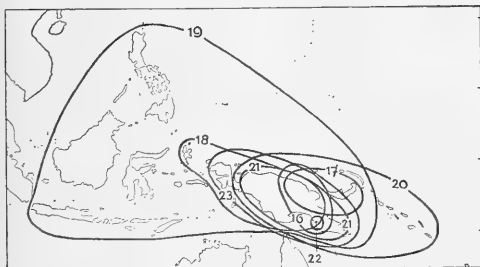


Fig. 15. Distribution of *Terminalia* series C(b): 16. *oreadum*, 17. *sepicana*, 18. *rubiginosa*, 19. *microcarpa*, 20. *complanata*, 21. *hypargyrea*, 22. *sogerensis*, 23. *longespicata*.

spirally arranged along the branchlets, at first sericeous becoming nearly glabrous above or more frequently retaining some appressed hairs especially near the base of the midrib, densely appressed-pilose or appressed-pubescent beneath, often minutely verruculose above and pellucid-punctate, sometimes opaque, broadly obovate, obovate, obovate-elliptic or narrowly elliptic, 5–12 by  $2\frac{1}{2}$ – $5\frac{1}{2}$  cm, apex very variable, cuneate at the base; nerves 7–13 pairs often rather closely spaced; petiole appressed-pubescent or appressed-pilose, 1–2 cm. *Flowers* sessile, white, in axillary spikes, 7–13 cm long, rhachis sericeous. Bracts pilose to nearly glabrous, filiform, 2– $2\frac{1}{2}$  mm. *Lower receptacle* sericeous,  $1\frac{1}{2}$ –2 mm long (3– $3\frac{1}{2}$  mm in some older flowers but the fruit may have started to grow); upper receptacle scarcely developed. *Calyx*-lobes sericeous or sparsely appressed-pubescent outside, nearly glabrous inside, ovate-triangular,  $1\frac{1}{2}$  by 1 mm. Filaments glabrous, 3–4 mm; anthers  $\frac{1}{2}$  mm long. Disk pilose. Style glabrous, 5 mm. *Fruit* red or pink, at first sericeous eventually sparsely appressed-pubescent, elliptic to suborbicular in outline, much flattened, 2–3 by  $2\frac{1}{2}$ – $\frac{1}{2}$  cm, usually beaked, rather obscurely longitudinally circumalate, showing in cross-section a very irregular mass of sclerenchyma surrounded by large, irregular air-spaces.

Distr. *Malaysia*: New Guinea. Fig. 15.

Ecol. In rain-forest throughout the island up to 1350 m.

Note. Collectors' notes are conflicting as this species is described as a 'tall forest tree' and also as a 'tree of 10–12 m with horizontal branches in gallery extensions of rain-forest' and notes on the bark, etc., are also at variance. The corresponding specimens all seem to be conspecific as far as can be ascertained by studying the herbarium material.

**22. *Terminalia sogerensis* BAK. f. J. Bot. 61, Suppl. (1923) 14.—*T. rubiginosa* (non K. SCHUM.) SLOOT. Bull. Jard. Bot. Btzig III, 6 (1924) 30 *pro parte quoad specim.* FORBES 636.**

Tree 20–25 m. Young branchlets somewhat thickened, densely rufous-sericeous, indumentum persisting for some time, with a tendency towards sympodial branching. *Leaves* at first membranaceous later subcoriaceous, spirally arranged, somewhat crowded at the tips of the branchlets, at first densely rufous-sericeous and undersurface remaining rufous-tomentose while the upper surface is more or less glabrescent with the exception of the midrib, minutely verruculose and pellucid-punctate at one stage but these characters disappear as the leaf-blade becomes older and thicker, elliptic, narrowly elliptic or obovate-elliptic, 6–12 by  $2\frac{1}{2}$ –6 cm, shortly and bluntly acuminate at the apex, cuneate at the base; nerves 10–13 pairs, often rather closely spaced; domatia not conspicuous; petiole rufous-tomentose, 8–15 mm, glands not conspicuous. *Flowers* pale yellow, in axillary spikes 5–7 cm long; rhachis rufous-tomentose. Bracts pilose, filiform, 3–6 mm. *Lower receptacle*

(ovary) densely sericeous, 1 mm long; upper receptacle scarcely developed. *Calyx*-lobes ovate, glabrous 0.8 mm long. Filaments glabrous, 2 mm; anthers 0.2–0.3 mm long. Disk barbate. Style glabrous,  $1\frac{1}{2}$  mm. *Fruit* appressed-pubescent broadly compressed-ellipsoid 20–28 by 12–19 by 6 mm when dried, very narrowly circumalate, beaked at the apex, showing large air-spaces in cross-section.

Distr. *Malaysia*: E. New Guinea (Papua: Sogeri Region and Kanosia). Fig. 15.

Ecol. Swamp forests at low altitude. Fruits adapted to water-dispersal.

Note. This may prove to be conspecific with *T. hypargyrea* K. SCHUM. & LAUT. but with the small amount of material at present available it seems advisable to maintain it as a distinct species.

**23. *Terminalia longespicata* SLOOT. Bijdr. Combr. (1919) 19, t. 1, f. 1–5; Bull. Jard. Bot. Btzig III, 6 (1924) 29.—*T. phaeoneura* DIELS, Bot. Jahrb. 57 (1922) 419.—Fig. 14, 16.**

Tree 15–35 m, buttressed. Bark grey-green to brown, resinous; wood straw-yellow or dark yellow. Young branchlets rufous-tomentose or rufous-tomentellous, retaining some indumentum for a considerable period. *Leaves* chartaceous, spirally arranged along the branchlets, at first rufous- or golden-sericeous later glabrescent above except for the midrib but remaining rufous-tomentose or rufous-tomentellous beneath, especially on the nerves, not conspicuously verruculose or pellucid-punctate, elliptic, narrowly elliptic, obovate-elliptic, narrowly obovate-elliptic or oblanceolate, 5–12 by  $2\frac{1}{2}$ –6 cm, usually acuminate rarely rounded at the apex, cuneate to rounded at the base, sometimes with 2 rather inconspicuous glands; nerves 8–16 pairs, rather closely spaced and prominent beneath; domatia not conspicuous; petiole rufous-tomentose later glabrescent, 7–15 mm. *Flowers* sessile in axillary spikes 5–17 cm long; rhachis rufous-tomentose. Bracts hairy, filiform, recurved,  $2\frac{1}{2}$  mm. *Lower receptacle* (ovary) rufous-tomentose, 2 mm long, somewhat narrowed at the apex; upper receptacle rufous-tomentose, shallow-cupuliform, 1 by  $1\frac{1}{2}$  mm. *Calyx*-lobes tomentose or pubescent, ovate, 1 mm long. Filaments glabrous, 3 mm; anthers 0.2 mm long. Disk pilose. Style glabrous,  $3\frac{1}{2}$ –4 mm. *Fruit* red, pubescent when young, glabrous when mature, suborbicular to elliptic in outline, laterally compressed, 20–23 by 13–18 by 8–12 mm (when dried), apiculate at the apex, showing in cross-section a band of sclerenchymatous tissue surrounding the loculus with radial, spoke-like projections alternating with large air-chambers.

Distr. *Malaysia*: New Guinea (fairly widespread). Fig. 15.

Ecol. A large tree, sometimes dominant, in riverine lowland, swamp forest. The fruits are clearly adapted to water-dispersal.

Uses. The timber appears to be of little use. The fleshy part of the fruit is eaten by the natives.

Vern. *Karija, karo, kihim.*



Fig. 16. *Terminalia longespicata* SLOOT. a. Flowering branch,  $\times \frac{2}{3}$ , b. part of spike,  $\times 8$ , c. bud in section,  $\times 20$ , d. flower,  $\times 12$  (after VAN SLOOTEN).

**24. *Terminalia catappa* LINNÉ**, Syst. Nat. ed. 12, 2 (1767) 674 (err. 638); MANT. 1 (1767) 128; BL. Bijdr. (1825) 642, SPAN. Linnaea 15 (1841) 203; MIQ. Fl. Ind. Bat. 1, 1 (1855) 599; SCHEFFER, Bull. Jard. Bot. Btzg 1 (1876) 69, 73, 94; KURZ, For. Fl. Burm. 1 (1877) 454; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 444; K. SCHUM. in K. SCHUM. & HOLLR. Fl. Kais. Wilh. Land (1889) 83; KING, J. As. Soc. Beng. 66, 2 (1897) 331; BAK. f. in C. W. ANDREWS, Mon. Christm. Isl. (1900) 177; K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 465; K. & V. Bijdr. Booms. 9 (1903) 26; MERR. Philip. J. Sc. C. Bot. 4 (1909) 642; EN. BORN. (1921) 423; EN. PHILIP. 3 (1923) 150; BACK. Schoolfl. Jav. (1911) 489; SLOOT. Bijdr. Combr. (1919) 8; Bull. Jard. Bot. Btzg III, 6 (1924) 14; GAGNEP. Fl. Gén. I.-C. 2 (1920) 743; W. H. BROWN, Minor Prod. Philip. For. (1921) 162, f. 55; RIDL. Fl. Mal. Pen. 1 (1922) 705; HEYNE, Nutt. Pl. N. I. (1927) 1176; CRAIB, Fl. Siam. En. 1 (1931) 621; BURK. Dict. (1935) 2137; CORNER, Wayside Trees (1940) 193, t. 44, 45; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 7.—*Catappa* RUMPH. Herb. Amb. 1 (1741) 174, t. 68.—*T. moluccana* LAMK, Encycl. 1 (1783) 349.—*T. latifolia* BLANCO, Fl. Filip. (1837) 376, non *T. latifolia* Sw. (1788).—*T. catappa* var.

*macrocarpa*, *rhodocarpa* et *chlorocarpa* HASSK. Tijds. Nat. Gesch. & Phys. 10 (1843) 145; Flora (1844) 606.—*T. mauritiana* (non LAMK) BLANCO, op. cit. ed. 2 (1845) 264.—*Myrobalanus catappa* KUNTZE, Rev. Gen. Pl. (1891) 237.—**Fig. 17, 18.**  
Deciduous tree, 10–35 m. Wood brown or reddish, rather heavy and close-grained. Young branchlets thickened, densely sericeous-tomentose or pubescent fairly quickly glabrescent. *Leaves* chartaceous or papyraceous, spirally arranged and crowded at the ends of the branches, spreading, usually shiny and glabrous but occasionally appressed-pubescent or tomentose especially on the lower surface, minutely verruculose above and below, typically obovate sometimes elliptic-obovate or even elliptic, rounded or shortly acuminate at the apex and somewhat narrowed below the middle to a subcordate base usually with 2 glands, 8–25(–38) by 5–14(–19) cm, varying considerably in size and shape (see notes); usually with c. 6–9 pairs of rather widely spaced nerves; domatia often present, some mes hairy; petiole thick, usually sericeous-pubescent, 5–15(–20) mm. Seed-leaves transversely elliptic or kidney-shaped. *Flowers* white or whitish, sessile in axillary spikes 8–16 cm long, in which the majority of the flowers are usually ♂, a few ♀ flowers only being present



Fig. 17. *Terminalia catappa* L. Tuft of leaves with inflorescences (CORNER). Courtesy Government Printer Singapore.





Fig. 18. *Terminalia catappa* L. Young tree near Tanglin Corner, Singapore (CORNER). Courtesy Government Printer Singapore.

towards the base; rhachis usually appressed-pubescent, sometimes glabrous. Bracts *c.* 1 mm long, early caducous. Lower receptacle (ovary) sericeous or glabrous, usually 2–4 mm long, occasionally up to 7 mm long; upper receptacle usually nearly glabrous, shallow-cupuliform,  $1\frac{1}{2}$  by 3 mm. Calyx-lobes ovate-triangular,  $1-1\frac{1}{2}$  mm long. Filaments glabrous, 2 mm; anthers  $\frac{1}{2}$  mm long. Disk barbate. Style glabrous, 2 mm. Fruit a

usually glabrous, reddish, yellowish or greenish drupe, ovoid or ellipsoid, more or less laterally compressed or scarcely compressed, circumalate with a stiff rigid wing *c.* 2 mm broad or wing obsolete and scarcely conspicuous, very variable in size,  $3\frac{1}{2}-7$  by  $2-5\frac{1}{2}$  cm, cultivated races often having conspicuously larger fruits than the wild plants.

Distr. Tropical Asia, N. Australia and Poly-



nesia, commonly planted in the tropics, in *Malaysia*: throughout the area although apparently rather rare on the mainland of Sumatra and in Borneo.

Ecol. Sandy or rocky beaches 0–5 m altitude, a typical constituent of the *Barringtonia* formation. VAN DER PUL (Trop. Nat., Jub. no, 1936, 97–99) observed regular dispersal of *kētapang* fruits through fructivorous bats all over Meeuwen Island (SW. Java) and elsewhere and found chewed kernels under trees where they devour their fruits. He concludes that they are distinctly diplochorous, viz. dispersed both by sea-water and by bats. This is confirmed by DOCTERS VAN LEEUWEN for Krakatau Island. *T. catappa* was also found in the beach-forest of the newly formed Anak Krakatau (cf. VAN BORSSUM WAALKES, Trop. Nat. 32, 1950, 42–43).

Wood anat. MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 375; PEARSON & BROWN, Comm. Timb. 1 (1932) 501; REYES, Commonw. Philip. Dept Agr. Techn. Bull. 7 (1938) 368.

Uses. Often planted in avenues as a shade-tree, for which it is suitable because of its very regular shape. The timber is reddish and of good quality and is used for house- and boat-building, carts, planks, etc. The kernel of the fruit is edible and contains a colourless, fatty oil similar to almond oil. The bark contains tannin used as an astringent in dysentery and thrush. The leaves act as a sudorific and are applied to rheumatic joints. Bark and leaves are used for tanning leather.

Vern. *Amendoeira da India*, Portug., *Badamier*, Fr., *Etagenbaum*, Germ., *Indian* or *Singapore Almond*, E., *kētapang*, standard-Mal., Jav. Sund., *lingtak*, Mal. Pen.; Sumatra: *bēowa*, *kilaula*, Enggano, *gēntapang*, Atjeh, *katapang*, Toba-Batak, *lapahang*, Simalur, *katapieng*, Minangk., *katafa*, Nias; Lesser Sunda Isl.: *kētapas*, Timor, *klihi*, Pantar, *lisa*, Roti, *wewa*, Tenimber; Celebes: *sabrisé*, Sangir, *aarisei*, *talisei*, *dumpangang*, *lumpoyang*, Alf. Cel., *atapang*, Bug; Moluccas: *sadina*, *sarisa*, W. Ceram, *sertalo*, S. Ceram, *kajané*, *sarisalo*, Saparua, *sērisa*, Sepa, *sarasa*, Haruku, *sirisal*, Nusa-laut, *lisa*, Buru, *tasi*, Sula, *kliis*, Weda, *gnusa*, Ternate, Tidore, Galela, *tiliho*, Tobelo, *tiliso*, Loda, *wéw*, Key; Philippines: *talisai* (standard), *almandras*, *almandro*, Span., *banilak*, *dalasa*, *kalisai*, *hitam*, Pamp., *dalinsi*, Bik., *dalisai*, Ibn., *logo*, *lugo*, Ilk., *savidug*, Iv., *salaisai*, Ig., *salisai*, Sbl., *taisai*, Sulu, *talisi*, Yak., *yalisai*, Tag.; W. New Guinea: *kalis*, *kris*, *ruge*.

Notes. This very well-known tree is a characteristic feature of the tropical urban landscape for it is one of the commonest avenue trees. The branches come off in regular tiers giving the species a curiously regular appearance.

The tree sheds its leaves all at once, quite suddenly, usually twice a year (January or February and July or August). Unlike most tropical trees, the leaves turn first yellow, then vivid red before falling giving a well-marked 'autumn colour'.

As is perhaps to be expected in a frequently planted species with an edible kernel, the fruits show great variation in size, colour and shape

and there has apparently been some selection in cultivating large-fruited races. This variation has made it difficult to place the species in the key, where it has to appear several times and it is still possible that atypical specimens may escape correct identification. It has been necessary to use as a determining character the subcordate base to the leaf which is clear enough in the great majority of specimens. In young plants, however, and probably on branches of rapid growth leaves with a cuneate base and petioles longer than normal can be found and closely simulate leaves of other species of the genus. Specimens from Timor and neighbouring islands seem to be particularly atypical in this respect and in the absence of fruits their determination is doubtful. A normal leaf-specimen, even in the absence of fruits, can be distinguished from nearly all other species of *Terminalia* by the obovate leaves, with comparatively few lateral nerves, considerably narrowed towards the base, where the lamina is clearly subcordate and not decurrent into the rather short, thick petiole.

**25. *Terminalia samoensis* RECHINGER**, in FEDDE, Rep. 4 (1907) 229.—Fig. 14.

Tree. Bark hard, grey, scaly. Young branchlets fairly thick, fulvous-tomentose eventually glabrescent with sympodial growth. *Leaves* chartaceous, papyraceous or membranaceous, spirally arranged and somewhat crowded towards the ends of the branchlets, pubescent above, more densely so on the midrib, pubescent to tomentose beneath, obovate, broadly obovate, broadly elliptic or suborbicular, 6–20 by 4½–12½ cm, rounded at the apex and usually at the base, usually (but sometimes obscurely) minutely verruculose above, manifestly, though not very conspicuously, pellucid-punctate; nerves 7–10 pairs; petiole fulvous-tomentose, 1–3½ cm. *Flowers* greenish-white, sessile, in axillary spikes 6–11 cm long; rachis fulvous-tomentellous or pubescent. Bracts pubescent, filiform, 1 mm, early caducous. *Lower receptacle* (ovary) glabrous or sparsely pubescent, 4–5 mm long, much constricted above the ovary; upper receptacle glabrous, shallow-cupuliform 1½ by 4 mm. *Calyx*-lobes glabrous, ovate-triangular, 1½ mm long. Filaments glabrous, 3 mm; anthers 0.4 mm long. Disk pilose. Style glabrous, 2 mm. *Fruit* glabrous, fleshy and red when ripe, compressed-ellipsoid or compressed-ovoid, 1.7–2.2 by 1–1.3 cm; pericarp of dried fruit showing in cross-section an inner sclerenchymatous layer c. 0.7 mm thick, surrounded by a middle layer c. 1–2 mm thick with many small air-spaces, followed by an outer layer of corky consistency.

Distr. Polynesia (Samoa, Gilbert Isl., Ellice Isl., Marshall Isl.), Melanesia (Solomon Islands: Owa Raha), in *Malaysia*: New Ireland (Kavieng) and Celebes (Miangas Island). Fig. 19.

Ecol. A littoral species growing on coral limestone in Miangas Isl. The fruits are probably water-borne.

Vern. *Salise*.

Notes. *T. saffordii* MERR. from Guam with

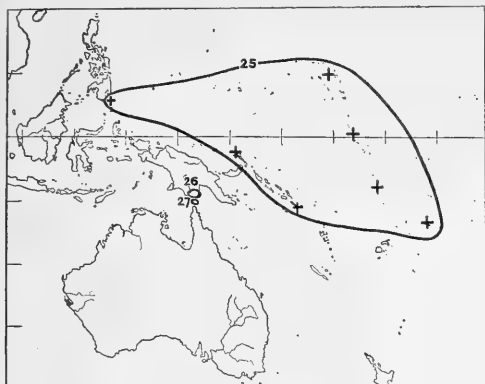


Fig. 19. Distribution of *Terminalia* series E:  
25. *samoensis*, 26. *crassifolia*, 27. *insularis*.

glabrous inflorescence, slightly smaller fruits and shorter petioles may prove to be the same species when more material is available, but the name *T. samoensis* has priority.

**26. *Terminalia crassifolia* EXELL, J. AGR. ARB. 20 (1939) 319.**

Small tree, 6–8 m. Young branchlets rather thick, appressed-pubescent, later glabrescent, growth sympodial. *Leaves* subcoriaceous to coriaceous, spirally arranged and crowded at the ends of the branchlets, glabrous above, rather obscurely verruculose, sparsely appressed-pubescent beneath, especially towards the base of the midrib, obovate, 6–11 by  $3\frac{1}{2}$ – $7\frac{1}{2}$  cm, rounded and often shortly apiculate at the apex, cuneate at the base with 2 glands near the base of the midrib; nerves 5–8 pairs, rather widely spaced except at the base; domatia often present, usually hairy; petiole appressed-pubescent, fairly stout, 5–18 mm. *Flowers* sessile in axillary spikes 9–11 cm long; rachis appressed-pubescent. Bracts not seen, presumably early caducous. *Lower receptacle* (ovary) densely sericeous,  $1\frac{1}{2}$  mm long; upper receptacle sparsely appressed-pubescent, shallow-cupuliform, 3 by 1 mm. *Calyx*-lobes deltoid,  $1\frac{1}{2}$  mm long. Filaments glabrous, 3– $3\frac{1}{2}$  mm; anthers 0.7–0.8 mm long. Disk barbate. Style glabrous, 2 mm. *Fruit* appressed-puberulous, when mature only very sparsely so, when ripe 'dark purple, somewhat compressed,  $1\frac{1}{2}$  by 1 cm' when dried slightly compressed ellipsoid, apiculate, 12–13 by 7–8 mm, endocarp showing in cross-section a central sclerenchymatous zone surrounded by a zone honey-combed with air-spaces.

*Distr. Malaysia:* South New Guinea (Papua: Mabaduan). Fig. 19.

*Ecol.* Common in savannah-forest substage and in light rain-forest on granite slopes, apparently under semi-arid climatic conditions.

*Note.* The fruits are among the smallest known of the drupaceous type in Malaysia.

**27. *Terminalia insularis* C. T. WHITE, Proc. R. Soc. Queensl. 55 (1944) 64.**

Tree. Branchlets stout, somewhat swollen at the tips. *Leaves* spirally arranged,  $\pm$  crowded at the apices of the branchlets, fairly densely pubescent above, densely and softly pubescent beneath at time of flowering, losing most of their indumentum in old age, not verruculose or punctate, obovate or obovate-cuneate, 8–17 by  $4\frac{1}{2}$ –9 cm, usually rather abruptly acuminate at the apex and cuneate at the base, nerves 6–9 pairs; petiole at first pubescent later glabrescent,  $3\frac{1}{2}$ – $4\frac{1}{2}$  cm. *Flowers* (*ex descr.*) in densely flowered spikes 8–17 cm long. *Lower receptacle* (ovary) densely sericeous 2 mm long. *Calyx*-lobes sparsely pilose outside, deltoid. Filaments 5 mm. Disk barbate. *Fruit* sparsely pubescent, ellipsoid or ovoid, scarcely compressed,  $1\frac{1}{2}$ –2 by 0.9–1 cm.

*Distr.* Thursday Island, expected to occur in South New Guinea. Fig. 19.

*Note.* I have not seen the type but two fragments in the British Museum Herbarium, E. COWLEY 30 and an unnamed collector, both from Thursday Island, must be this species. The only discrepancy is in the length of the petioles, which is  $3\frac{1}{2}$  to  $4\frac{1}{2}$  cm in the specimens seen while they are 1– $2\frac{1}{2}$  cm long in the original description. The length I have given fits in much better with C. T. WHITE's key character 'leaves three or four times as long as the petiole'.

**28. *Terminalia bellirica* (GAERTN.) ROXB. Pl. Corom. 2 (1805) 54, t. 198 ('*bellirica*'); MIQ. Fl. Ind. Bat. 1, 1 (1855) 600; KURZ, For. Fl. Burm. 1 (1877) 455; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 445; KING, J. As. Soc. Beng. 66, 2 (1897) 329; KOORD. Exk. Fl. 2 (1912) 671; SLOOT. Bijdr. Combr. (1919) 15; Bull. Jard. Bot. Btzg III, 6 (1924) 22; GAGNEP. Fl. Gén. I.-C. 2 (1920) 749; RIDL. Fl. Mal. Pen. 1 (1922) 704; HEYNE, Nutt. Pl. N. I. (1927) 1175; CRAIB, Fl. Siam. En. 1 (1931) 601; BURK. Dict. (1935) 2136; JAPING & OEY DJOEN SING, Tectona 29 (1936) 675; CORNER, Wayside Trees (1940) 193; MEEUSE in BACK. Fl. Java (em. ed.) 4, fam. 101 (1944) 7.—*Myrobalanus bellirica* GAERTN. Fruct. 2 (1791) 90, t. 97, f. a–d ('*bellirina*').—*T. punctata* ROTH, Nov. Sp. (1821) 381.—*T. laurinioides* T. & B. *ex* MIQ. l.c.—*T. lauriformis* T. & B. [Cat. Hort. Bog. 1855, 252, *ined.*] *ex* SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 22.—*T. moluccana* (non LAMK) MIQ. *tom. cit.* (1855) 601; K. SCHUM. in K. SCHUM. & HOLLER. Fl. Kais. Wilh. Land (1889) 84.—*T. belerica* var. *laurinioides* CLARKE, l.c.; BACK. Schoolfl. Java (1911) 490; KOORD. Atl. Baumart. 1 (1913) t. 75.—*Myrobalanus laurinioides* KUNTZE, Rev. Gen. Pl. (1891) 237.—Fig. 14, 20.**

A deciduous tree, 25–50 by 2 m, with large buttresses. Young branchlets thick, at first densely, later sparsely, rufous-appressed-pubescent. *Leaves* at first papyraceous later subcoriaceous or coriaceous, spirally arranged along the branchlets or crowded at the ends of the branchlets, sometimes whorled, rufous-sericeous when very young, soon becoming glabrous or almost glabrous, usually



Fig. 20. *Terminalia bellirica* (GAIRDS.) RONB. Tree near Kuala Trengganu, Malaya (CORNER 1937).

conspicuously minutely verruculose above and less conspicuously so beneath, pellucid-punctate for a time but eventually opaque, typically broadly elliptic or obovate-elliptic, sometimes elliptic and narrowly oblanceolate in seedlings, 4–18 by 2–11 cm, rounded or obtuse or sometimes acuminate at the apex, rounded, obtuse or cuneate at the base; nerves usually 6–8 pairs, rather widely spaced; domatia usually absent or inconspicuous; petiole at first pubescent soon glabrescent, generally long in relation to the lamina, usually *c.* 3 cm but sometimes up to 9 cm. *Flowers* sessile, yellowish, buds subglobose, in axillary spikes 3–15 cm long; rhachis rufous- or fulvous-appressed-pubescent. Bracts absent or very early caducous. *Lower receptacle* (ovary) densely sericeous or tomentellous, 1½–2 mm long; upper receptacle shallow-cupuliform, 1 by 4 mm, sericeous. *Calyx*-lobes recurved, deltoid, 1½ mm long. Filaments glabrous, 3 mm; anthers 0.8 mm long. Disk rufous- or fulvous-barbate. Style glabrous, 4 mm. *Fruit* densely and finely velutinous or sericeous, subglobose to broadly ellipsoid when dried, 2–2.8 by 1.8–2.2 cm, usually with 5 well-marked longitudinal ridges, endocarp densely sclerenchymatous, with no trace of air-spaces; exocarp hard, 1–2½ mm thick when dried, dark in section.

*Distr.* Ceylon, India, Burma, Indo-China, Siam, in *Malaysia*: Malay Peninsula, Sumatra (Eastcoast Res., Palembang, Lampongs), Java, N. Borneo (Sandakan), Lesser Sunda Islands (Bali, Wetar), Central Celebes (Wataipi) and Moluccas (Ambon & Key Islands). Fig. 21.

*Ecol.* A deciduous tree, remaining leafless, however, for only a short period, on periodically dry soils in deciduous monsoon forest, also in rain-forests on red soil. In Java mainly in Central and East Javan teak-forests, mostly at low altitudes but up to 600 m in Java.

*Wood anat.* (*T. bellerica* var. *laurinoides* CLARKE) MOLL & JANSSENTIUS, Mikr. Holzes 3 (1914) 367; (*T. bellerica* ROXB.) PEARSON & BROWN, Comm. Timb. 1 (1932) 506.

*Uses.* There are conflicting accounts as to the durability of the timber but in Malaysia it is not considered of much value, although said to be good for firewood and charcoal. In Indo-China,

however, it is used for making wheels and its durability is said to be improved by immersion in water. The fruit is one of the commercial myrobalans used for tanning leather, for a black dye (together with sulphate of iron), to economize in the use of indigo and for making ink. The unripe fruit is purgative and the ripe fruit astringent, being extensively used in India for dropsy, haemorrhoids and diarrhoea. In Java the fruits are sold with the seeds removed as 'djalawé' in native pharmacies. The kernels can be eaten but are somewhat dangerous as they produce a narcotic effect. The tree also yields an insoluble gum in considerable quantity. For further details see BURKILL (*l.c.*), HEYNE (*l.c.*), and PEARSON & BROWN (*l.c.*).

Vern. *Djeuheu, djoho, djaha, gamprit, J, Md, dj. kébo, dj. kéling, dj. sapi, J, djélawai, méntalun, uji*, Mal.Pen., *simar kulihap*, Sumatra, *ulu bēlu*, Lampongs, *tietiemalong*, Ambon, *koenfit, niesmetan*.

## 29. *Terminalia macadamii* EXELL, *Blumea* 7 (1953) 324.—Fig. 14.

Tree *c.* 40 m by 80 cm. Bark green. Wood creamy, porous. Young branchlets rufous-tomentellous and retaining their indumentum for a considerable time. *Leaves* spirally arranged along the branches, chartaceous, at first densely rufous-tomentellous, later glabrescent above but retaining their indumentum especially on the nerves and reticulation beneath, rather obscurely minutely verruculose above, pellucid-punctate, elliptic or more rarely obovate-elliptic, 8½–18 by 3½–9 cm, usually somewhat acuminate at both apex and base; nerves 9–12 pairs, domatia not conspicuous; petiole rufous-tomentellous, 1–3 cm. *Flowers* unknown. *Fruit* tomentellous when young becoming glabrous when mature, oblong-ellipsoid, usually scarcely compressed, 2½–3½ by 1.3–1½ cm, rather obscurely longitudinally ridged, showing in cross-section a sclerenchymatous inner layer extended radially in spoke-like projections.

*Distr. Malaysia*: New Guinea (Papua: Milne Bay). Fig. 23.

*Ecol.* Rain-forest at low altitude.

*Uses.* The wood is described as 'creamy and porous'.

Vern. *Muru muru widi*.

## 30. *Terminalia solomonensis* EXELL, *J. Bot.* 73 (1935) 132.

Buttressed tree, 15–30 m, with flatly spreading, whorled branches. Bark brown, wood yellow. Young branchlets rather stout and very early glabrescent although the terminal buds are sericeous. *Leaves* papyraceous, spirally arranged along the branchlets or sometimes whorled, glabrous somewhat shiny and rather conspicuously minutely verruculose on both surfaces, manifestly pellucid-punctate, elliptic, narrowly elliptic, obovate-elliptic or oblong-elliptic, 12–24 by 6½–9 cm, acuminate at the apex, cuneate at the base; nerves 9–14 pairs; domatia absent or inconspicuous; petiole glabrous, 3½–5 cm, usually with 2 glands near the centre. *Flowers* sessile, cream, brown or yellow, in axillary spikes 7–14 cm long; rhachis appressed-

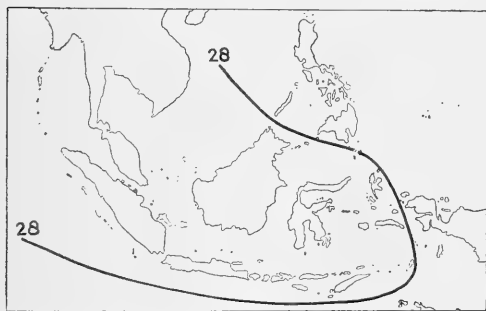


Fig. 21. Distribution of *Terminalia* series F: 28. *bellerica*.

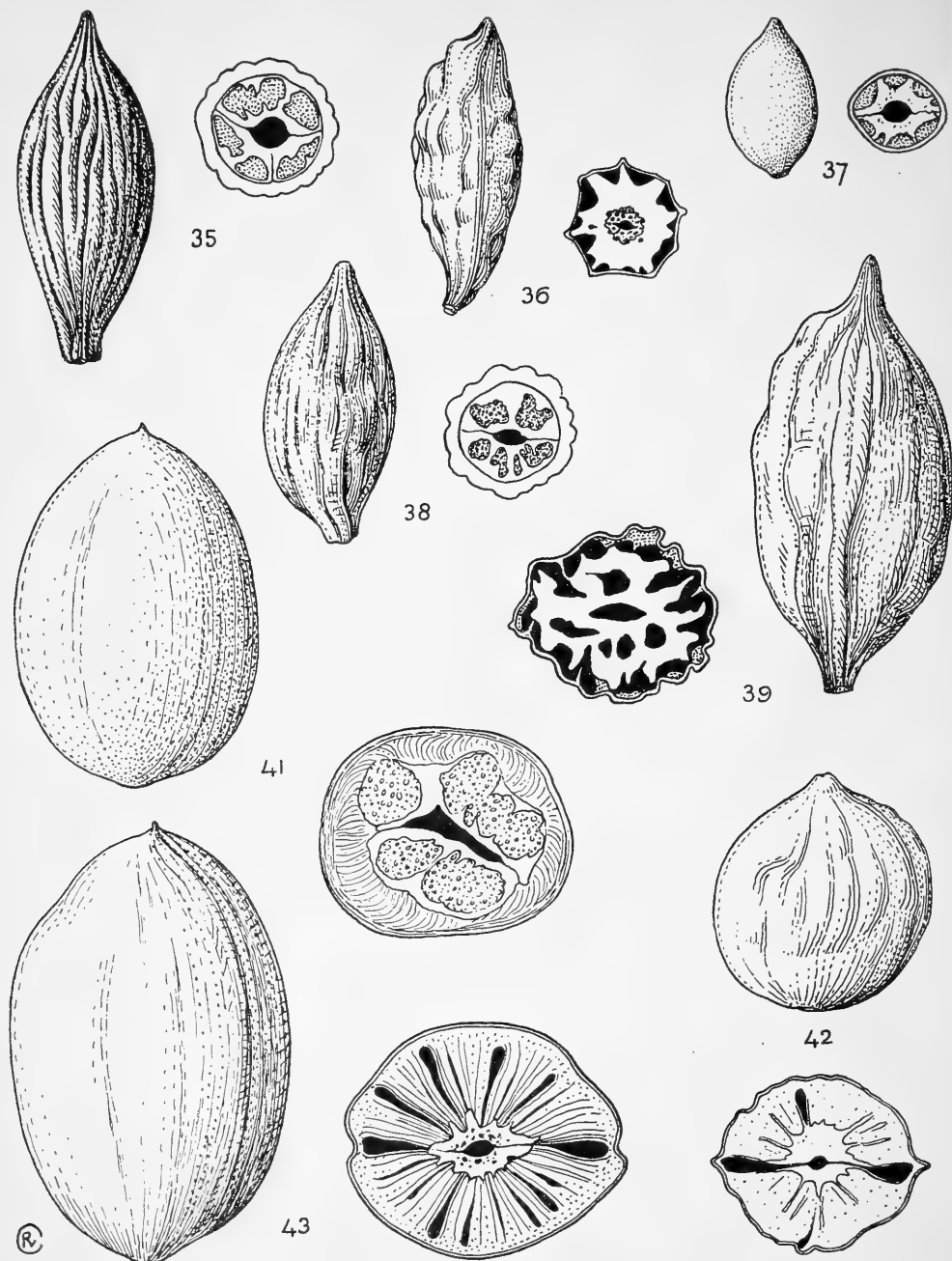


Fig. 22. Fruits of *Terminalia* numbered to correspond with the species in the text; a fruit of each species and its cross-section; all from herbarium material; loculus and hollows black, sclerenchyma white, alveolar tissue dotted; nat. size.—35. *T. nitens* (ELMER 18410), 36. *T. lundquistii* (LUNDQUIST 105), 37. *T. plagata* (RAMOS & EDANO 44338), 38. *T. pellucida* (ELMER 13241), 39. *T. papuana* (BRASS & VERSTEEGH 12542), 41. *T. foetidissima* (ELMER 18058), 42. *T. molii* (MOL 207), 43. *T. phellocarpa* (NGADIMAN SF 34743).

pubescent. Bracts pubescent, filiform,  $2\frac{1}{2}$  mm. *Lower receptacle* (ovary) densely tomentose or sericeous,  $1\frac{1}{2}$ –3 mm; upper receptacle sericeous, shallow-cupuliform, 1 by  $2\frac{1}{2}$  mm. *Calyx*-lobes hairy outside glabrous within, ovate-triangular, often recurved,  $2$ – $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm. Filaments glabrous,  $3\frac{1}{2}$  mm; anthers 0.7 mm long. Disk barbate. Style glabrous  $3\frac{1}{2}$ –5 mm. *Fruit* black when ripe, appressed-pubescent when young, glabrous when mature, ellipsoid, slightly compressed,  $3\frac{1}{2}$ –4 by  $2$ – $2\frac{1}{2}$  by 1.8 cm, apiculate, showing in cross-section a thick sclerenchymatous band with rather irregular spoke-like projections and included in the sclerenchyma a layer near the centre containing dispersed air-chambers.

Distr. Solomon Islands (Guadalcanar, Malaita and Isabel Islands), in *Malaysia*: E. New Guinea (Papua: Lower Fly River; Morobe and Budabara). Fig. 23.

Ecol. Rain-forest, also in secondary grassland, from sea-level to 300 m.

Uses. The fruit is said to be eaten by the natives.

**31. *Terminalia kangeanensis* SLOOT.** Bull. Jard. Bot. Btzg III, 6 (1924) 35, fig. 4.—Fig. 14.

Medium-sized tree. Young branchlets fairly stout at first with appressed fulvous or golden pubescence, later glabrescent. *Leaves* papyraceous or chartaceous, spirally arranged and crowded at the ends of the branchlets, appressed-pubescent when young, soon glabrescent, usually conspicuously minutely verruculose above and manifestly pellucid-punctate, sometimes (or perhaps more correctly at some stages) not verruculose and opaque, obovate, obovate-elliptic or elliptic, 10–17 by 5–9½ cm, rounded, obtuse or shortly acuminate at the apex, cuneate at the base; nerves 8–12 pairs, with glabrous or only slightly hairy domatia in their axils; petiole at first appressed-pubescent, eventually glabrescent, 2–3 cm. *Flowers* sessile, in axillary spikes 8–12 cm long; rhachis appressed-pubescent. Bracts not seen. *Lower receptacle* (ovary) densely sericeous  $2\frac{1}{2}$  mm long, narrowed at the apex then expanding into the shallow-cupuliform appressed-pubescent upper receptacle, 1 by 3 mm. *Calyx*-lobes ovate, triangular appressed-pubescent outside, glabrous inside, 2 by 2 mm. Filaments glabrous, 4 mm; anthers 0.4 mm long. Disk pilose. Style glabrous, 4 mm. *Fruit* glabrous when mature, ellipsoid, only slightly compressed,  $2\frac{1}{2}$ – $3\frac{1}{2}$  by 1.3– $1\frac{1}{2}$  cm, rather obscurely longitudinally ridged, showing in cross-section a band of sclerenchymatous tissue round the loculus with about 5 spoke-like projections with rather large honey-combed air-chambers lying between them.

Distr. *Malaysia*: Java (Karimondjawa Islands?, N of Semarang), Kangean Arch. (N of Bali-Lombok). Fig. 23.

Ecol. Tree growing along the shore in the *Barringtonia* association and in mixed rain-forest on limestone at 50 m. The fruit appears adapted for water-distribution.

Notes. The fruits are less flattened than those of *T. microcarpa* and are somewhat smaller than

those of *T. solomonensis*. The Karimondjawa specimen, KOORDERS 188 (BO), is sterile.

**32. *Terminalia celebica* EXELL,** Blumea 7 (1953) 325.—Fig. 14.

Tree, 20 m. Young branchlets glabrous and even the terminal bud has only a few hairs, growth sympodial. *Leaves* chartaceous, spirally arranged and  $\pm$  crowded at the ends of the branchlets, glabrous, densely minutely verruculose above, obscurely pellucid-punctate or opaque, elliptic or narrowly elliptic, 7–15 by  $3\frac{1}{2}$ –7 cm, acuminate at the apex, narrowly cuneate at the base; nerves 9–12 pairs; domatia scarcely conspicuous, glabrous; petiole glabrous,  $1\frac{1}{2}$ –3 cm. *Flowers* yellowish, honey-scented, sessile, in axillary spikes 6–13 cm long; rhachis fulvous-tomentellous. Bracts at first conspicuous, glabrous, filiform, 3–9 mm, soon caducous,  $\sigma$  flowers very numerous and rather densely arranged at the upper end of the spike, with stalks  $1\frac{1}{2}$ –3 mm long,  $\phi$  flowers towards the base of the spike, less numerous. *Lower receptacle* (ovary) narrowed at the apex, sericeous,  $2$ – $2\frac{1}{2}$  mm long, upper receptacle shallow-cupuliform, 1 by 2 mm, sparsely pubescent or nearly glabrous. *Calyx*-lobes almost glabrous, triangular, 2 by 1.2 mm. Filaments glabrous, 4–5 mm; anthers  $\frac{1}{2}$  mm long. Disk barbate. Style glabrous, 4 mm. *Fruit* glabrous, oblong-ellipsoid, somewhat laterally compressed, when dry 4– $4\frac{1}{2}$  by 1.8–2 by 1.4–1.6 cm, apiculate at the apex, showing in cross-section a band of sclerenchymatous tissue 3–4 mm thick, including in it some isolated air-chambers, especially in a ring round the loculus, and radially extended into 9–10 spoke-like projections with further air-chambers between them.

Distr. *Malaysia*: Central Celebes (Malili). Fig. 23.

Ecol. Primary forest, 250 m.

Vern. *Tolihe poete*.

Note. The structure of the fruit is very similar to that of *T. solomonensis* but it is longer and relatively narrower in shape and rather more compressed.

**33. *Terminalia beccarii* EXELL,** Blumea 7 (1953) 325.

Tree. Young branchlets sparsely appressed-pubescent at first, very soon becoming glabrous. *Leaves* chartaceous, spirally arranged along the branches, sparsely appressed-pubescent on the nerves otherwise glabrous, very obscurely verruculose, opaque, elliptic or obovate-elliptic, 7–14 by 4– $7\frac{1}{2}$  cm, acuminate at the apex, obtuse at the base, with 2 or more rather conspicuous glands, black when dried, near the base of the midrib and each extending along, or in the direction of, a lateral nerve; nerves 8–9 pairs, somewhat impressed above and prominent beneath; petiole sparsely appressed-pubescent or almost glabrous, 2–4 cm. *Flowers* ( $\sigma$  not seen) in axillary spikes up to 18 cm long; rhachis glabrous or almost glabrous. Bracts not seen. *Lower receptacle* (ovary) glabrous 2 mm long; upper receptacle scarcely developed. *Calyx*-lobes ovate acute, 2 by

1½ mm, glabrous outside, pilose inside, recurved at the apex. Filaments glabrous, 4 mm; anthers ½ mm long. Disk barbate. Style glabrous, 4 mm. Fruit unknown.

Distr. *Malaysia*: New Guinea (Mt Arfak). Fig. 23.

Notes. For some remarks on the glands see EXELL (*l.c.*).

**34. *Terminalia soembawana* SLOOT.** Bijdr. Combr. (1919) 11; Bull. Jard. Bot. Btzg III, 6 (1924) 21 ('*sumbawana*').—*T. trivialis* SLOOT. *tom. cit.* (1924) 38, f. 5.—Fig. 14.

Tree 15 m. Young branchlets rather stout, at first golden or fulvous-sericeous, later appressed-pubescent, finally glabrous. Leaves papyraceous or chartaceous, spirally arranged at the ends of the branchlets, sparsely appressed-pilose or almost glabrous, manifestly minutely verruculose above, rather obscurely pellucid-punctate, obovate or obovate-elliptic, 7–20 by 4–8½ cm, rounded and usually acuminate or obtuse at the apex, cuneate at the base, usually with 2 black (when dried) glands on each side of the midrib about 5–10 mm from the base; nerves 10–16 pairs, domatia usually present but not hairy; petiole sericeous, eventually sparsely sericeous or nearly glabrous, 1–2 cm. Flowers in axillary spikes 5–10 cm long; rhachis appressed-pubescent. Bracts hairy, filiform, 1–2 mm, soon caducous. Lower receptacle (ovary) glabrous or nearly so, sometimes with a few appressed hairs, 1½–2½ mm long; upper receptacle glabrous, shallow-cupuliform, 1 by 2½–3 mm. Calyx-lobes deltoid or ovate, 1 by 1 mm, glabrous outside, hairy within. Filaments glabrous, 3–4 mm; anthers 0.6–0.7 mm long. Disk barbate. Style glabrous, 3½–4 mm. Fruit glabrous, ellipsoid, at both ends, 3–3½ by 1.3–1½ cm when dried, showing in cross-section a circular band of sclerenchymatous tissue surrounding the loculus extended into 4–6 very irregular, radial projections partially enclosing honey-combed air-chambers between them.

Distr. *Malaysia*: Lesser Sunda Islands (Kangean Arch., Sumbawa, and Timor). Fig. 23.

Ecol. Mixed forest, 70–240 m.

Vern. *Kĕtapang gunung*, Kangean.

Notes. In his note sub *T. trivialis* VAN SLOOTEN (*l.c.*) says '... it agrees with *T. edulis* (BLANCO) MERR., but it differs by its compressed, pilose, in sicco rugose fruit', a statement which may cause confusion. He certainly intended 'but the latter differs etc.' instead of 'but it differs' for the cited description of the fruit applies to that of *T. edulis* not *T. trivialis*.

**35. *Terminalia nitens* PRESL.** Abh. Kön. Böhm. Ges. Wiss. V, 6 (1851) 574; MERR. Philip. J. Sc. C. Bot. 4 (1909) 645; En. Philip. 3 (1923) 152.—*T. belerica* var. *laurinoides* (non CLARKE) FERN.-VILL. Novis. App. (1880) 80.—*T. merrillii* ELM. Leaf. Philip. Bot. 7 (1915) 2581.—Fig. 22.

Young branchlets at first sericeous appressed-pubescent, soon glabrescent. Leaves chartaceous, spirally arranged along the branchlets, sometimes

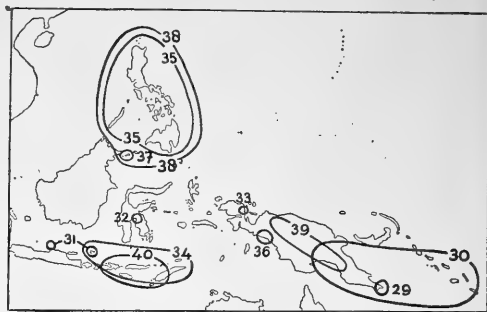


Fig. 23. Distribution of *Terminalia* series G: 29. *macadamii*, 30. *solomonensis*, 31. *kangeanensis*, 32. *celebica*, 33. *beccarii*, 34. *soembawana*, 35. *nitens*, 36. *lundquistii*, 37. *plagata*, 38. *pellucida*, 39. *papua*, 40. *zollingeri*.

somewhat crowded towards their tips, sometimes pseudo-whorled, usually glabrous or nearly so, occasionally pubescent on the nerves below, shining above, not verruculose, sometimes rather obscurely verruculose below, obovate, obovate-elliptic or narrowly obovate, 7–12 by 3½–6½ cm, rounded and sometimes acuminate at the apex, cuneate at the base; nerves 6–9 pairs; domatia present but usually not hairy; petiole glabrous or sparsely pubescent, 1–1½ cm, with 2 glands near the apex. Flowers sessile, in axillary spikes 7–10 cm long; rhachis golden-appressed-pubescent. Bracts glabrous or nearly so, filiform, 3–4 mm. Lower receptacle (ovary) usually glabrous rarely sparsely appressed-pubescent, 3–4 mm long; upper receptacle glabrous, shallow-cupuliform, 1 by 3–3½ mm. Calyx-lobes glabrous outside, hairy inside, broadly ovate or deltoid, 2 by 2 mm. Filaments glabrous, 4 mm; anthers 0.8 mm long. Disk barbate. Style glabrous, 4–5 mm. Fruit glabrous ellipsoid, attenuated at each end, often beaked at the apex, 3–5 by 1.8–2 cm, showing in cross-section a ring of sclerenchymatous tissue round the loculus extended radially into 5–6 spoke-like projections with relatively large air-chambers filled with alveolar tissue between them; exocarpe rather thick and hard when dried.

Distr. *Malaysia*: throughout the Philippines. Fig. 23.

Ecol. Primary forests at low and medium altitudes.

Wood anat. REYES, Commonw. Philip. Dept Agr. Techn. Bull. 7 (1938) 372.

Vern. *Anegep*, *arinbukal*, *kalautit*, *pongud*, *Ilk.*, *bisal*, *Pang.*, *dalinsi*, *daminsil*, *malagabi*, *pansaket*, Tag., *kalaotit*, Ig., *kalaupi*, Ibn., *kanaupong*, Mbo, *magatalishai* Bis., Mag., *magatalishai*, Bik., *mantalisi*, Sulu, *sakat*, Pamp., *samondo*, *tagit*, Tagb., *samuloko*, Bag., *tujongmanuk*, P. Bis.

**36. *Terminalia lundquistii* EXELL.** Blumea 7 (1953) 326.—Fig. 22.

Tree 21 m. Young branchlets rather stout, at



first rufous-sericeous, soon sparsely appressed-pubescent, at length glabrescent. *Leaves* subcoriaceous, spirally arranged, glabrous above, appearing resinous or glutinous beneath, almost glabrous or sometimes pubescent on the nerves, elliptic or obovate elliptic, 8–13 by  $4\frac{1}{2}$ – $8\frac{1}{2}$  cm, somewhat acuminate at the apex, cuneate at the base; nerves 8–11 pairs with glabrous domatia; petiole at first rufous-sericeous, later sparsely appressed-pubescent or glabrous,  $1\frac{1}{2}$ –2 cm. *Flowers* (not seen) in axillary spikes 14 cm long; rhachis almost glabrous. Bracts not seen. *Fruit* glabrous, ellipsoid, somewhat beaked at the apex, irregularly verruculose and also rather densely minutely verruculose, 4–5 by  $1\frac{1}{2}$ –2 cm, showing in cross-section some honey-combed tissue around the loculus surrounded by a thick band of sclerenchyma with short radial spoke-like projections.

Distr. *Malaysia*: South New Guinea (Mimika). Fig. 23.

Ecol. Primary forest on sandy soil, 50 m.

Vern. *Keari*.

**37. *Terminalia plagata* MERR.** Philip. J. Sc. 30 (1926) 414.—Fig. 22.

Tree. Young branchlets densely fulvous-appressed-pubescent, later glabrescent. *Leaves* coriaceous or subcoriaceous, spirally arranged and somewhat crowded at the ends of the branchlets, shiny and glabrous above except for some appressed pubescence on the midrib, with close prominent reticulation, rather densely appressed-puberulous beneath, eventually nearly glabrous, spatulate or oblanceolate, 4–9 by 2–4 cm, rounded or blunt at the apex, cuneate at the base; nerves 7–10 pairs, with rather prominent domatia in their axils; petiole sericeous, 2–8 mm. *Flowers* unknown. *Fruits* at first sparsely appressed-pubescent, becoming glabrous, ellipsoid, 2–2.8 by  $1.2$ – $1\frac{1}{2}$  cm, sometimes somewhat laterally compressed, beaked at the apex, showing in cross-section a stellate band of sclerenchymatous tissue about 2 mm thick round the loculus with some air-chambers included in it and with short radial projections and a relatively wide outer band of alveolar tissue.

Distr. *Malaysia*: Philippines: Sulu group (Tawi-Tawi Isl., close to NE. Borneo). Fig. 23.

**38. *Terminalia pellucida* PRESL.** Abh. Kön. Böhm. Ges. Wiss. V, 6 (1851) 574; MERR. Philip. J. Sc. C. Bot. 4 (1909) 644; EN. Philip. 3 (1923) 152.—*T. sumatrana* (non MIQ.) NAVES in BLANCO, Fl. Filip. ed. 3 (1877–83) t. 200.—*T. iwahigensis* ELM. Leaf. Philip. Bot. 5 (1913) 1760.—Fig. 22.

Tree. Young branchlets considerably thickened at the tips, at first rufous-sericeous, soon glabrescent, growth sympodial. *Leaves* papyraceous to chartaceous or sometimes subcoriaceous, spirally arranged and crowded at the tips of the branchlets, sericeous when very young eventually glabrous or almost glabrous except for appressed pubescence on the midrib, conspicuously minutely verruculose above and pellucid-punctate at certain stages of development but these characters are not seen when the leaf is young and it becomes opaque

as it grows old, obovate, narrowly obovate or obovate-spathulate, 5–12 by  $2\frac{1}{2}$ – $6\frac{1}{2}$  cm, rounded at the apex, cuneate at the base; nerves 8–10 pairs, domatia present in their axils, sometimes hairy; petiole sericeous, eventually sparsely appressed-pubescent, or glabrous,  $1\frac{1}{2}$ –2 cm, usually with 2 glands at or above the middle. *Flowers* in axillary spikes 5–8 cm long; ♂ numerous, glabrous,  $1\frac{1}{2}$ –2 mm stalked; ♀ sessile, fewer, towards the base of the spike, rhachis nearly glabrous. Bracts glabrous, filiform, 1 mm. *Lower receptacle* (ovary) glabrous,  $1\frac{1}{2}$ –2 mm long; upper receptacle glabrous, shallow-cupuliform 1 by 2 mm. *Calyx*-lobes broadly deltoid, glabrous, 0.8 mm long. Filaments glabrous,  $1\frac{1}{2}$ –2 mm (probably immature); anthers  $\frac{1}{2}$  mm long. Disk barbate. Style glabrous,  $1\frac{1}{2}$  mm. *Fruit* glabrous, ellipsoid,  $2.2$ – $4\frac{1}{2}$  by 1.2–2 cm, often beaked and stipitate, showing in cross-section a complete ring of sclerenchymatous tissue 5–6 mm broad in which 5–6 irregular masses of alveolar tissue are embedded or the latter may be more developed at the expense of the sclerenchyma which is sometimes little more than a framework.

Distr. *Malaysia*: Philippine Islands (Luzon, Mindanao, Sulu Arch., and Palawan). Fig. 23.

Ecol. Forests at low altitudes.

Wood anat. REYES, Commonw. Philip. Dept. Agr. Techn. Bull. 7 (1938) 367. Brief comments.

Vern. *Dalinsi*, *sobo-sobo*, Tag., *aritongtong*, *dulaon*, Ilk., *hakit*, *sakut*, Sbl., *saket*, Pang., Sbl., *solo-solo*, Pamp., *aalisai-tandok*, Sulu, *upung-upung*, S. L. Bis.

Note. The specimens described as *T. iwahigensis* have rather larger fruits but there seems to be no difference in structure.

**39. *Terminalia papuana* EXELL**, Brittonia 2 (1936) 246.—*T. brassii* EXELL, *tom. cit.* (1936), *non T. brassii* EXELL (1935)—Fig. 22.

Large, deciduous tree, 20–30 m. Bark grey, grey-brown or black. Young branchlets stout, at first fulvous- or rufous-sericeous, later glabrescent. *Leaves* papyraceous, spirally arranged and crowded at the ends of the branchlets, very shiny above, sparsely pilosulose or glabrous, rather obscurely verruculose, appressed-pubescent below eventually glabrescent, manifestly but not very conspicuously pellucid-punctate, obovate to obovate elliptic, 10–20 by 5–13 cm, rounded and usually shortly acuminate at the apex, subcuneate or slightly cordate at the base; nerves 8–12 pairs, domatia usually present but without indumentum other than that covering the undersurface of the lamina; petiole appressed-pubescent, becoming nearly glabrous, 2–3 cm. *Flowers* white, sessile, in axillary spikes 5–10 cm long; rhachis appressed-pubescent. Bracts not seen. *Lower receptacle* (ovary) densely sericeous 2–3 mm long, upper receptacle scarcely developed. *Calyx*-lobes triangular,  $1\frac{1}{2}$  by 2 mm, subsericeous outside, nearly glabrous within. Filaments glabrous, 3 mm; anthers 0.8 mm long. Disk barbate. Style glabrous, 3 mm. *Fruit* glabrous when mature, ellipsoid, not laterally compressed, 5–6 by  $2\frac{1}{2}$ –3 cm, beaked or apiculate at



the apex, shortly stipitate at the base, showing in cross-section an irregular mass of sclerenchymatous tissue enclosing pockets of alveolar tissue, which breaks down to form air-chambers.

Distr. *Malaysia*: New Guinea (Idenburg River, Bernhard Camp, and Mafulu). Fig. 23.

Ecol. Rain-forest, from the flood-plains up to 850–1200 m.

Note. The description of the fruit is taken from BRASS & VERSTEEGH 12542 (A) from Idenburg River, Bernhard Camp. It has been a puzzle which fruiting specimens to correlate with the flowering

material described as *T. papuana*. It is to be hoped that the right choice has been made. Other as yet unidentified specimens from lower altitudes with much smaller fruits are also very similar in leaf.

40. *Terminalia zollingeri* EXELL, *nom. nov.*—*T. mollis* T. & B. [Cat. Hort. Bog. 1855, 252 *ined.*] *ex* SLOOT. Bull. Jard. Bot. Btzg III, 6 (1924) 30, f. 2, *non T. mollis* OLIV. (1871).—*T. macrocarpa* SLOOT. *op. cit.* 4 (1922) 282, *nomen nudum*, *non T. macrocarpa* KURZ (1877), *nomen nudum*.—Fig. 24.

Tree, 30 m. Young branchlets fulvous-tomen-



Fig. 24. *Terminalia zollingeri* EXELL. a. Flowering branch,  $\times 1/2$ , b.  $\sigma$  flower,  $\times 3 1/2$ , c.  $\sigma$  flower,  $\times 3 1/2$ , d.  $\sigma$  flower in longitudinal section,  $\times 3 1/2$ , e. fruit,  $\times 1/2$ , f. stone,  $\times 1/2$  (after VAN SLOOTEN).

tose, somewhat or considerably thickened. *Leaves* chartaceous to coriaceous, crowded at the ends of the branchlets, pubescent above, fulvous-tomentose or densely pubescent beneath, obovate, narrowly obovate or oblanceolate, 10–28 by  $3\frac{1}{2}$ – $11\frac{1}{2}$  cm, rounded, acute or acuminate at the apex, cuneate at the base; nerves 10–20 pairs; domatia sometimes present but usually not very conspicuous; petiole fulvous-tomentose, rather stout, 3–30 mm. *Flowers* greenish, in axillary spikes 10–18 cm long; rhachis fuscous-tomentose. Bracts early caducous. *Lower receptacle* (ovary) appressed-pilose, 3–4 mm long; upper receptacle rather sparsely appressed-pubescent, shallow-cupuliform, 1 by 3 mm. *Calyx*-lobes outside hairy towards the base, inside glabrous, deltoid,  $1\frac{1}{2}$  by  $1\frac{1}{2}$  mm. Filaments glabrous, 4 mm; anthers  $\frac{1}{2}$  mm long. Disk barbate. Style glabrous, 3 mm. *Fruit* at first appressed-pubescent, glabrous when mature, oblong-ellipsoid, scarcely compressed,  $4\frac{1}{2}$ – $7\frac{1}{2}$  by  $2\frac{1}{2}$ –4 cm.

**Distr.** *Malaysia*: Lesser Sunda Islands (Sumbawa, West Timor). Fig. 23.

**Ecol.** From sea-level to 900 m.

**Vern.** *Nismeten*, *sarisedoro*, *sërisë*, Sumbawa, Timor.

**Note.** The name *Terminalia mollis* T. & B. first occurs in a catalogue of the Buitenzorg Botanic Garden printed in 1855 but the issue was deliberately suppressed and only 2 copies were kept for internal use in the curator's office at Bogor, and are now incorporated in the Bibliotheca Bogoriensis so that names in it cannot be considered as validly published in spite of VAN SLOOTEN's opinion (*loc.*) to the contrary. For a fuller discussion see VAN STEENIS (Bull. Jard. Bot. Btzg III, 13, 1933, 117). This standpoint as regards Cat. Hort. Bog. (1855) allows the retention of *T. mollis* OLIV. for the African species.

**41. *Terminalia foetidissima*** GRIFF. Not. Pl. As. 4 (1854) 685; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 445; KING, J. As. Soc. Beng. 66, 2 (1897) 331; RIDL. Fl. Mal. Pen. 1 (1922) 704; CRAIB, Fl. Siam. En. 1 (1931) 621; BURK. Dict. (1935) 2141.—*T. sumatrana* MIQ. Fl. Ind. Bat. Suppl. (1860) 326; SLOOT. Bijdr. Combr. (1919) 18; Bull. Jard. Bot. Btzg III, 6 (1924) 27, f. 1.—*Myrobalanus foetidissima* KUNTZE, Rev. Gen. Pl. (1891) 237.—*T. oocarpa* MERR. Govt Lab. Publ. Philip. 17 (1904) 32 ('*ovocarpa*'); Philip. J. Sc. C. Bot. 4 (1909) 644; EN. Philip. 3 (1923) 152.—*T. ellipsoidea* MERR. *tom. cit.* (1904) 33.—*T. borneensis* SLOOT. Bijdr. Combr. (1919) 14; Bull. Jard. Bot. Btzg III, 6 (1924) 27, non *T. borneensis* RIDL. (1938).—**Fig. 22, 25.**

Tree up to 30 m by 75 cm. Young branchlets rather stout, rufous- or silvery-tomentose or sericeous soon glabrescent. *Leaves* chartaceous to subcoriaceous, spirally arranged along the branchlets or often crowded towards their tips, appressed-pubescent when young, usually glabrous or nearly glabrous when mature, sometimes rufous-pubescent on the nerves beneath, sometimes rather sparsely or more densely minutely verruculose

above and at times beneath, usually opaque or very obscurely pellucid-punctate, sometimes somewhat glaucous beneath, obovate, narrowly obovate or obovate-elliptic, 6–19 by  $2\frac{1}{2}$ –10 cm, rounded, shortly acuminate or obtuse at the apex, narrowly cuneate at the base; nerves 6–8 pairs, rather widely spaced, domatia usually present, mostly glabrous; petiole usually glabrous sometimes sparsely appressed-pubescent, 1– $2\frac{1}{2}$  cm, usually with 2 glands at or near the middle. *Flowers* sessile, in axillary spikes 10–16 cm long, rhachis appressed-pubescent or glabrous. Bracts filiform, hairy, 2 mm. *Lower receptacle* (ovary) rufous-tomentose or sericeous 2– $2\frac{1}{2}$  mm long; upper receptacle scarcely developed. *Calyx*-lobes triangular pubescent or nearly glabrous, 2 by  $1\frac{1}{2}$  mm. Filaments glabrous, 3–4 mm; anthers  $\frac{1}{2}$  mm long. Disk barbate. Style glabrous 3–4 mm. *Fruit* hairy at first, glabrous when mature, subglobose or ovoid, slightly laterally compressed (sometimes appearing more flattened due to drying),  $3\frac{1}{2}$ –5 by 3–4 cm, showing in cross-section thin irregular bands of sclerenchyma enclosing masses of alveolar tissue, the whole surrounded by a layer 3–5 mm thick of a spongy or fibrous nature.

**Distr.** Lower Burma (Mergui), Lower Siam (Puket), in *Malaysia*: Sumatra, Malay Peninsula, Borneo, Philippines. Fig. 26.

**Ecol.** Primary forests at low altitudes.

**Wood anat.** (*T. oocarpa* MERR.) REYES, Commonwealth. Philip. Dept Agr. Techn. Bull. 7 (1938) 373.

**Vern.** Mal. Pen.: *djêlawai*, *pêlawai*, *gêlawai*, M; Sumatra: *djaha koling*, *kaju kunjit*, *k. ngitari*, *kêtapang kantjil*, *k. talang*, Palembang., *djêdjaho*, Lampong, *marasêsap*, E. Kutai, *kêtapang gunung*, Pleihari, *semundo*, N. Born.; Philippines: *alilem*, *kalusit*, Ibn., *balinsil*, *paang-baliuis*, *talissai del monte*, *talissai gubat*, Tag., *bangkalauag*, *malagabi*, P. Bis., *dalinsi*, *dalinsoi*, Tag., Bik., *hakit*, Sbl., *kalutit*, *purukan*, Ilk., *magtalisai*, Bis., Mbo.

**Uses.** The timber is said to be not very durable. Bark is used in Palembang as a yellow or brown dye.

**42. *Terminalia molii* EXELL**, Blumea 7 (1953) 324.—**Fig. 22.**

Tree 30 m. Young branchlets slender, at first rufous or fulvous-tomentellous, later becoming glabrous. *Leaves* spirally arranged along the branchlets or somewhat crowded towards their tips, subcoriaceous, shiny and almost glabrous above, very obscurely verruculose, sparsely puberulous on the nerves below, opaque, obovate-elliptic,  $2\frac{1}{2}$ –7 by  $1\frac{1}{2}$ –3.2 cm, rounded at the apex, rounded to subcuneate at the base; nerves 5–6 pairs, rather widely spaced, with glabrous domatia in their axils; petiole puberulous, 8–15 mm, with 2 glands near the apex. *Flowers* not known. *Fruit* subglobose,  $3\frac{1}{2}$  by 3 cm when dried, shiny, glabrous, corky, showing in cross-section only a narrow band of sclerenchymatous tissue round the loculus surrounded by a broad corky layer.

**Distr.** *Malaysia*: Central Sumatra (Upper Indragiri, Tapanuli and Priaman). Fig. 26.

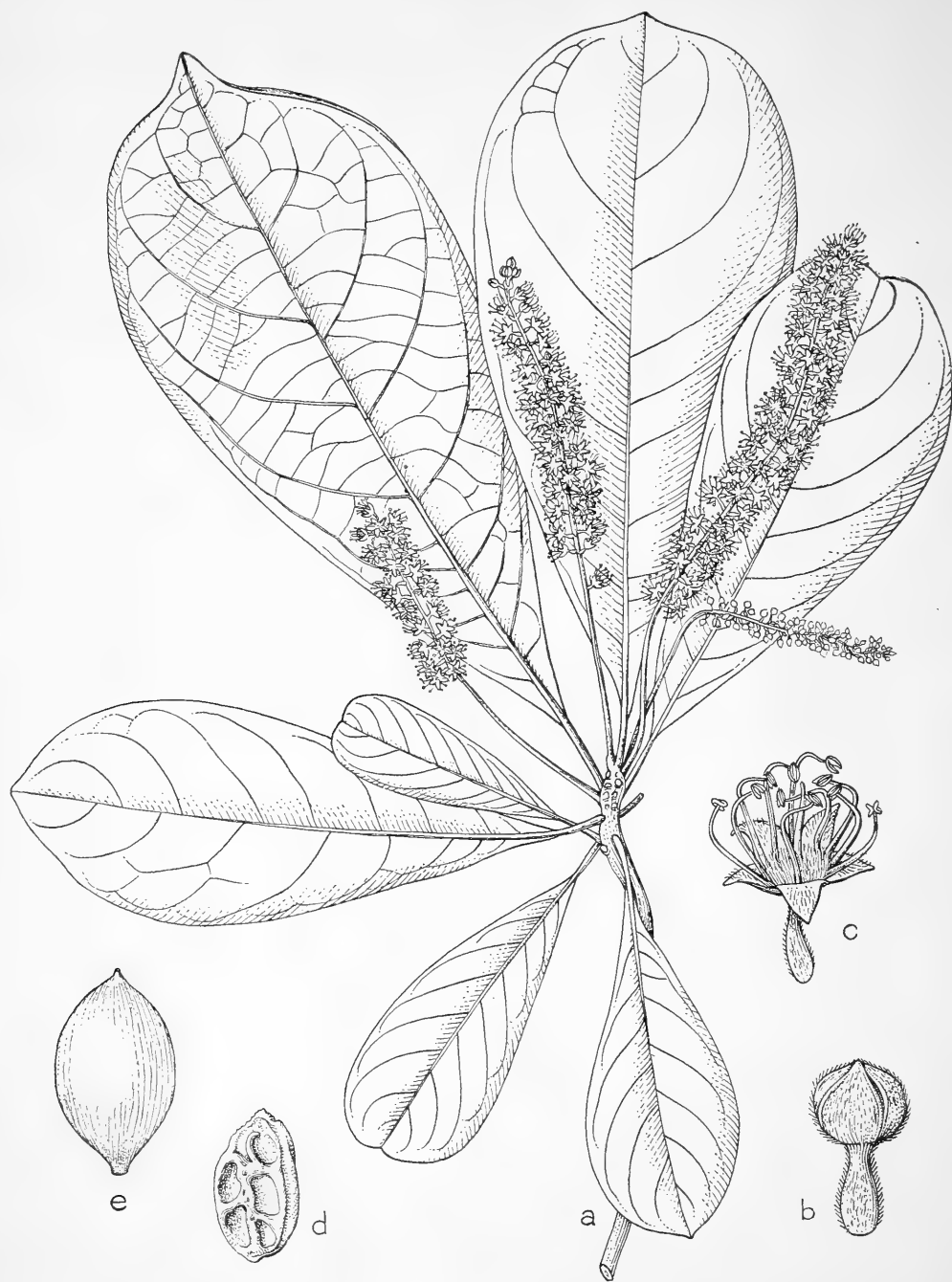


Fig. 25. *Terminalia foetidissima* GRIFF. a. Flowering branch,  $\times \frac{2}{3}$ , b. bud,  $\times 6$ , c. flower,  $\times 5$ , d. stone,  $\times \frac{2}{3}$ , e. fruit,  $\times \frac{2}{3}$  (after VAN SLOOTEN).

Ecol. Primary forest from sea-level to 10 m.  
Vern. *Katuko*, Pariaman, *simar kulihap*,  
Tapanuli.

**43. *Terminalia phellocarpa* KING, J. As. Soc. Beng.**  
66, 2 (1897) 330; RIDL. Fl. Mal. Pen. 1 (1922) 705;  
BURK. Dict. (1935) 2141; CORNER, Wayside  
Trees (1940) 194.—Fig. 22.

Tree 12–20 m. Young branchlets rufous-appressed-pilose, slender. *Leaves* subcoriaceous, spirally arranged, somewhat crowded at the ends of the branchlets, at first appressed-pubescent especially on the nerves, later almost glabrous, rather shiny above, not verruculose, opaque, elliptic to obovate,  $3\frac{1}{2}$ –8 by  $1\frac{1}{2}$ – $4\frac{1}{2}$  cm, rounded at the apex, cuneate to rounded at the base; nerves 5–6 pairs with glabrous domatia; petiole at first appressed-pubescent later glabrescent, 8–18 mm, usually with 2 glands a little above the middle. *Flowers* sessile, in axillary spikes 3–4 cm long, rhachis appressed-pubescent. Bracts filiform, hairy, 2 mm. *Lower receptacle* (ovary) rufous-tomentellous,  $1\frac{1}{2}$  mm long; upper receptacle scarcely developed. *Calyx*-lobes hairy, ovate-triangular, 2 by 1 mm, reflexed at the tips. Filaments glabrous, 3 mm; anthers 0.8 mm long. Disk barbate. Style not seen ( $\sigma$  flowers all immature). *Fruit* glabrous or nearly glabrous when mature, ellipsoid or suborbicular  $\pm$  laterally compressed, 6–7 by 4–5 by  $3\frac{1}{2}$  cm, usually shortly beaked at the apex showing in cross-section a very narrow band of sclerenchyma round the loculus and a thick corky layer with radiating fibres.

**Distr. Malaysia:** Sumatra (Palembang) and Malay Peninsula (Kedah, Perak, Malacca, Selangor, Johore, Singapore). Fig. 26.

Ecol. Swamp forests at low altitudes.

Vern. *Jêlawai*, *mêmpêlam babi* (pig's mango), *pauh kijang* (barking deer's mango, by confusion with *Iringia*), *pêlawai*; *têlissai*, Johore, *rênjang*, Mal. Pen.

**Notes.** According to CORNER (*l.c.*) the fruits are distributed mainly by floodwater floating them through the forest. This seems to be the *Terminalia* species most completely adapted for

water-distribution. The specimens from Sumatra have relatively broader, flatter fruits but material is insufficient to decide whether this difference is constant.

**44. *Terminalia copelandii* ELMER, Leaflet. Philip. Bot. 5 (1913) 1759; MERR. En. Philip. 3 (1923) 151.—*T. crassiramea* MERR. Philip. J. Sc. C. Bot. 12 (1917) 28; *l.c.* (1923).—*T. gigantea* SLOOT. Bull. Jard. Bot. Btzig III, 6 (1924) 33, f. 3.—*T. catap-poides* WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 249, f. 13.—Fig. 27, 29.**

Large tree up to 40 m. Bark grey or brown; sapwood whitish. Young branchlets much thickened, rufous-sericeous, becoming glabrous. *Leaves* spirally arranged, crowded at the thickened ends of the branchlets, rufous-tomentose when young, later sparsely appressed-pubescent or nearly glabrous, shining above, rather sparsely appressed-pubescent and sometimes minutely verruculose beneath, usually opaque, obovate-cuneate, 15–40 by  $4\frac{1}{2}$ –18 cm, rounded at the apex, narrowly cuneate below the middle and usually subcordate at the base; nerves 24–30 pairs, almost perpendicular to the midrib and rather closely spaced, domatia present but rather inconspicuous and not hairy; petiole thick, at first rufous-sericeous, becoming nearly glabrous, 5–10 mm. *Flowers* white, in axillary spikes 25–50 cm long; rhachis fulvous-tomentellous. Bracts filiform, 2 mm, soon caducous.  $\sigma$  Flowers numerous with appressed-pubescent stalks 3–5 mm long;  $\sigma$  flowers few, sessile towards the base of the spike. *Lower receptacle* (ovary) fulvous-sericeous, 3–6 mm long, narrowed at the apex into a slender stalk above the ovary; upper receptacle nearly glabrous, shallow-cupuliform, 1 by 3 mm. *Calyx*-lobes glabrous or nearly so, ovate-acuminate, 2 by  $1\frac{1}{2}$  mm. Filaments glabrous,  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm; anthers  $\frac{1}{2}$ –0.6 mm long. Disk barbate. Style glabrous, 4 mm. *Fruit* sparsely appressed-pilose or nearly glabrous when mature, ovoid or ellipsoid, sometimes slightly laterally compressed, sometimes rather obscurely 5-lobed, often shortly beaked at the apex,  $3\frac{1}{2}$ –6 by 2.2–3 cm, showing in cross-section very irregular and sinuate sclerenchymatous tissue partly enclosing and partly surrounded by alveolar tissue and a band of corky tissue 2–3 mm thick round the outside.

**Distr. Malaysia:** Sumatra (Simalur Isl., East and South coasts, Enggano, Krakatau), Borneo, Philippines, Lesser Sunda Islands (Flores), Celebes (Menado, Palopo, Buton Isl.), Moluccas (Talaud, Ternate, Sula, Ceram) and New Guinea. Fig. 28.

Ecol. Primary forests up to 500 m.

Wood anat. (*T. crassiramea* MERR.) REYES, Commonw. Philip. Dept Agr. Techn. Bull. 7 (1938) 366. Brief comments.

Uses. The timber is said to be similar to that of *T. catappa* L. The fruits are edible.

Vern. *Kêtapang*, M, *kêtapang darat*, *kêdawang*, Bencoolen, *mêrtapang*, *lahajang pajo*, Simalur, *katapang*, Karo; Philippines: *lanipâd*, S.L. Bis., C. Bis., Mbo., *nipon*, Bag., *talissai*, Tagb., *yanipô*, Mbo; *daliipo*, Palopo, *tusawara*, Sula.

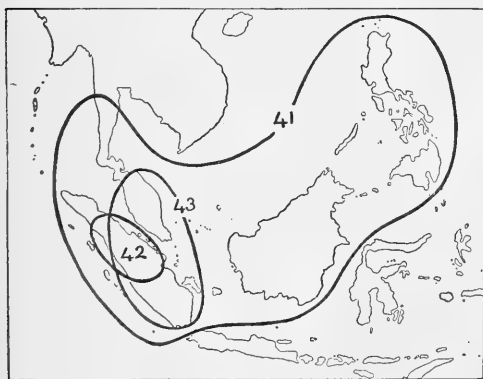


Fig. 26. Distribution of *Terminalia* series H:  
41. *foetidissima*, 42. *molii*, 43. *phellocarpa*.



Fig. 27. *Terminalia copelandii* ELMER. River bank of Kuala Bahewa, Karakelong Island (Talaud)  
(H. J. LAM).

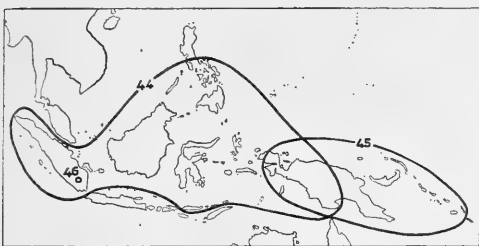


Fig. 28. Distribution of *Terminalia* series I: 44. *copelandii*, 45. *kaernbachii*, 46. *adenopoda*.

**Notes.** This is one of the largest leaved species of *Terminalia*. Sterile specimens may at times be confused with those of *T. catappa* owing to the fact that both species have obovate leaves with subcordate bases. The leaves of *T. copelandii* are relatively longer and narrower and have more numerous, more closely spaced lateral nerves. The inflorescences are usually longer and the fruits less compressed.

A sterile specimen collected at Endeh in Flores Island (FRI bb. 8923) may belong to this species.

**45. *Terminalia kaernbachii* WARB.** Bot. Jahrb. 18 (1893) 201; K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 466; DIELS, Bot. Jahrb. 57 (1912) 428; EXELL, J. Arn. Arb. 20 (1939) 318; C. T. WHITE, J. Arn. Arb. 31 (1950) 100.—*T. okari* C. T. WHITE, Proc. R. Soc. Queensl. 34 (1922) 46.—Fig. 29.

Buttressed tree, 35–45 m, with a large, spreading crown. Outer bark grey or grey-brown; inner purple or mauve, then brown against the cambium. Sapwood poorly defined, light with concentric wavy rings, sometimes almost porous. Young branchlets fulvous-tomentose, stout or very stout. *Leaves* coriaceous, spirally arranged along the branchlets, sometimes rather crowded in whorls towards the tips, finely reticulate above, somewhat shiny, remaining tomentose on the midrib and principal nerves, obscurely minutely verruculose, fulvous or rufous-tomentose below especially on the nerves, finally becoming nearly glabrous, rather obscurely pellucid-punctate at some stages of development, obovate-elliptic, narrowly obovate-elliptic or obovate-oblong, 12–35 by 5–12 cm, rounded and sometimes shortly acuminate or mucronate at the apex, cuneate or occasionally rounded at the base sometimes with 2 conspicuous black glands; nerves 10–18 pairs, domatia absent or inconspicuous; petiole fulvous- or rufous-tomentose or tomentellous, 1–2 cm, occasionally with 2 glands at or near the middle. *Flowers* sessile, rather large for the genus, in axillary spikes 10–12 cm long; rachis fulvous- or rufous-tomentose. Bracts hairy, caducous, 1 mm long. *Lower receptacle* (ovary) fulvous-tomentellous, 5 mm long; upper receptacle shallow-cupuliform, fulvous-tomentellous, 2–2½ by 6–7 mm. *Calyx*-lobes fulvous-tomentellous, broadly ovate-deltoid, 2½ by 2½–3 mm. Filaments glabrous, 6–12 mm;

anthers 0.8 mm long. Disk densely pilose. Style glabrous, 5–8 mm. *Fruit* red, fleshy, at first tomentose, nearly glabrous when ripe, ellipsoid, more or less laterally compressed, 6–17½ by 4–8 by 3½–6 cm, slightly beaked at the apex, the endocarp showing in cross-section a broad band of very hard sclerenchymatous tissue including in it some irregularly shaped and irregularly spaced air-chambers and a rather large loculus (up to 2½ by 2 cm in larger fruits) containing the edible kernel.

**Distr.** Solomon Islands (New Georgia), in *Malaysia*: New Guinea, S. Moluccas (Aru Islands). Fig. 28.

**Ecol.** Common in rain-forests and riverine forests up to 1000 m.

**Uses.** The wood is medium hard inclined to be brittle. The fruit, which is by far the largest known in the Combretaceae, is edible, the kernel being one of the best-flavoured tropical nuts and a favourite article of diet among the natives.

**Vern.** *Okari*, standard, *e mân*, Finschhafen.

**46. *Terminalia adenopoda* MIQ.** Fl. Ind. Bat. Suppl. (1860) 327; SLOOT. Bijdr. Combret. (1919) 21; Bull. Jard. Bot. Btzg III, 6 (1924) 40.

**Tree.** *Leaves* papraceous, glabrous when old except for some reddish hairs on the midrib and on the principal veins below, narrowly obovate-cuneate or narrowly oblong-elliptic, 25–35 by 9–12 cm, obscurely pellucid-punctate, sometimes rather prominently sparsely verruculose above (? pathological); nerves 14–17 pairs, without domatia; petiole with remains of a fulvous tomentum, 1½–3½ cm, with 4 or more glands. *Flowers* and *fruits* unknown.

**Distr.** *Malaysia*: Sumatra (Palembang: Baturadja). Fig. 28.

**Vern.** *Kaju kédjoh*, M.

**Note.** Only known from the inadequate original collection, TEYSMANN 3692 (BO, L, U) consisting of detached leaves and portions of branchlets. The material is in poor condition and both the rather sparse wart-like projections on the upper surface of leaf and the numerous 'glands' on the petiole may be pathological. In spite of the paucity of material there is enough to make it probable that the species is indeed a *Terminalia* and one not identifiable with any other known Sumatran species.

PELLA 12 from Celebes which VAN SLOOTEN (l.c. 1924) mentioned in a note *sub T. adenopoda*, though he rightly did not consider it to be the same, is probably *T. copelandii* ELM.

**47. *Terminalia canaliculata* EXELL,** Blumea 7 (1953) 327.

Semi-deciduous buttressed tree, 30 m. Bark brown or pale brown, flaky. Sapwood pale, heartwood red-brown. Young branchlets at first appressed-pubescent soon becoming sparsely pubescent or glabrous, growth sympodial. *Leaves* chartaceous, spirally arranged and somewhat crowded towards the ends of the branchlets, appressed-pubescent when young, soon glabrescent, obovate,

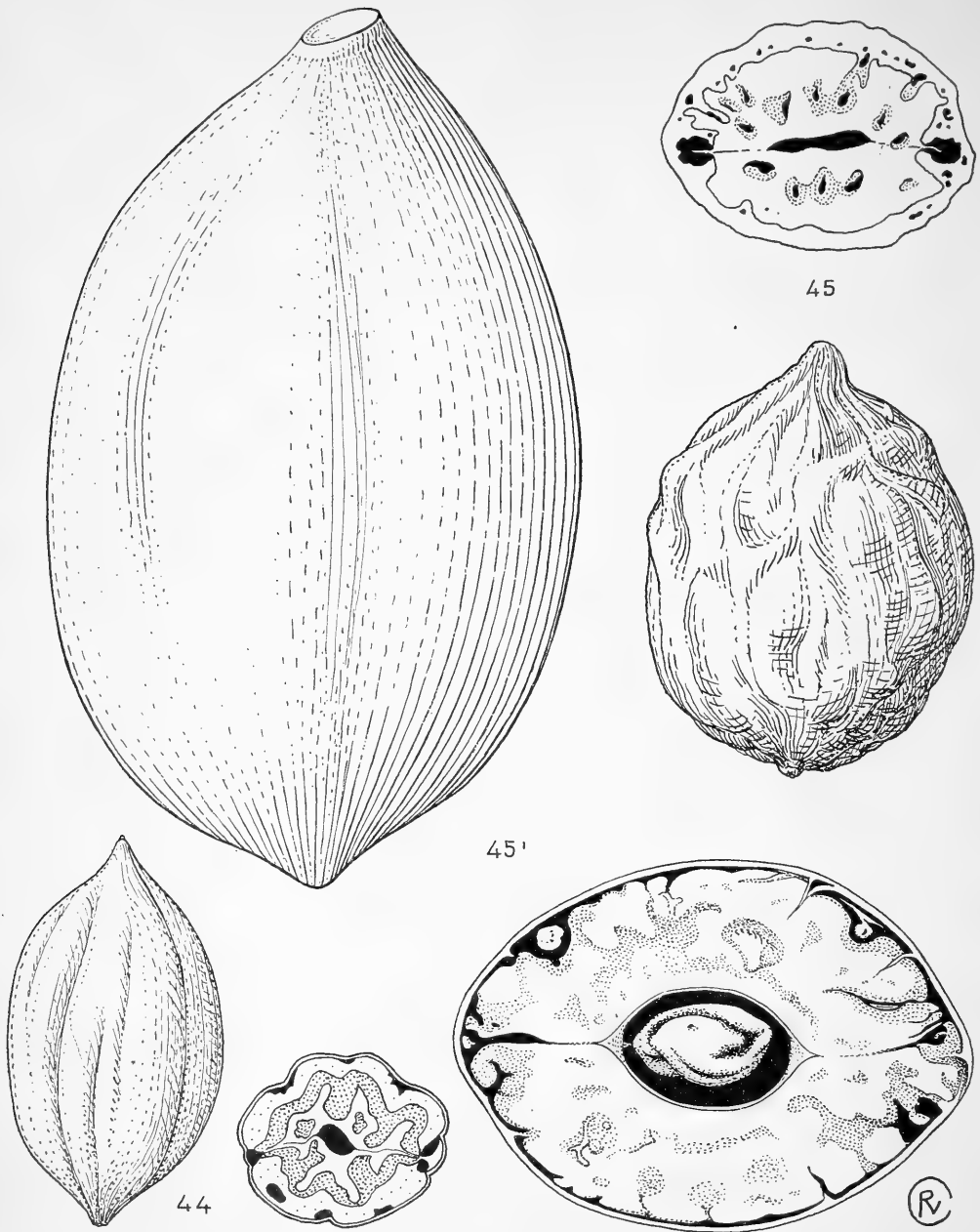


Fig. 29. Fruits of *Terminalia* numbered to correspond with the species in the text; of each species a fruit and its section; all from herbarium material; loculus and hollows black, sclerenchyma white, alveolar tissue dotted; nat. size.—44. *T. copelandii* (IDRIS 19), 45. *T. kaernbachii* (BRASS 6973) & 45'. *T. kaernbachii* (CARR 12239) (seed drawn in the section!) showing variation in size.



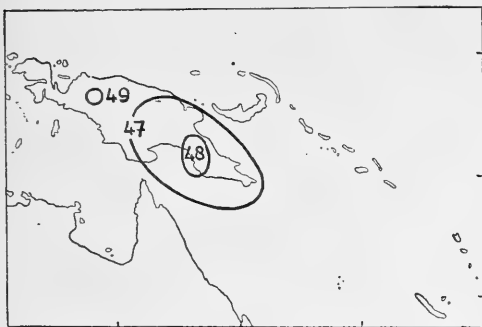


Fig. 30. Distribution of *Terminalia* series J, K, and L: 47. *canaliculata*, 48. *archboldiana*, 49. *capitulata*.

obovate-elliptic or elliptic, 8–15 by 4–7 cm, rounded and shortly acuminate at the apex, cuneate at the base, with numerous transverse canal-like mucilage cavities conspicuously visible with a lens on the upper surface and appearing translucent with transmitted light; nerves 9–13 pairs; domatia frequent, usually showing perforations of the lamina; petiole sparsely appressed-pubescent or glabrous, 1½–3 cm. *Flowers* white, in axillary spikes 10–13 cm long; rhachis appressed-pubescent. Bracts caducous. ♂ *Flowers* stalked; stalk appressed-pubescent, 1–1½ mm; ♀ fewer, at the base of the spike, sessile. *Lower receptacle* (ovary) sericeous, 2–2½ mm long; upper receptacle scarcely developed. *Calyx*-lobes sparsely pubescent outside, pilosulose inside, triangular 2½ by 1½ mm. Filaments glabrous, 3 mm; anthers ½ mm long. Disk barbate. Style unknown. *Fruit* unknown.

*Distr. Malaysia:* New Guinea (Papua: Palmer River, Oriomo River, and Milne Bay). Fig. 30. Ecol. Canopy tree in forests on the lower ridges and swampy flats at low altitude.

*Vern. Kama*, Upper Waria, *gara*, Oriomo River.

*Note.* This species is remarkable for the linear markings on the upper surface of the leaf. These are translucent when the leaf is held up to the light. Dr C. A. REINDERS-GOUWENTAK describes them as canal-like cavities containing mucilage found above the xylem of the smaller veins and within the xylem of the larger and medium-sized veins.

**48. *Terminalia archboldiana* EXELL, Brittonia 2 (1936) 137.**

Tree up to 30 m, with flatly spreading branches. Bark pale brown, fissured, scaly; wood hard, yellow-brown. Young branchlets slender, minutely appressed-puberulous, buds sericeous. *Leaves* coriaceous or subcoriaceous, spirally arranged, sometimes whorled or crowded towards the ends of the branchlets, shiny and sparsely appressed-pubescent or glabrous above, appressed-pubescent eventually glabrescent beneath, not or rather obscurely verruculose, opaque, obovate or

obovate-elliptic, 3–7 by 1½–3½ cm, rounded or blunt at the apex, cuneate at the base, 2 glands sometimes present on the midrib 5–10 mm from the base; nerves 5–6 pairs; domatia often present but usually not hairy; petiole appressed-pubescent, 2–4 mm. *Flowers* sessile, white, greenish or yellowish, buds pointed, in short, axillary, sometimes subcapitate spikes 2½–3 cm long; rhachis sericeous. Bracts sericeous, 1–2 mm, early caducous. *Lower receptacle* (ovary) 1½–2½ mm long, sericeous; upper receptacle scarcely developed. *Calyx*-lobes sericeous or almost glabrous, recurved, triangular, 2 by 1½ mm. Filaments glabrous, 2 mm; anthers 0.4 mm long. Disk barbate. Style glabrous, 3 mm. *Fruit* sericeous when young, later more sparsely appressed-pubescent, subglobose to ellipsoid, when dried 8 by 7 mm (perhaps immature).

*Distr. Malaysia:* E. New Guinea (Papua: Rona and Kanosia) Fig. 30.

Ecol. A common tree in hillside rain-forest at 450 m, found in open savannah at the same altitude; also recorded in forest at Kanosia at 15 m.

*Note.* L. J. BRASS describes this species as a common tree up to 30 m high growing in hillside forest at Rona, Laloki River and it was originally described from BRASS 3642 from this locality. C. E. CARR found it again in open savannah in the same district and at the same altitude but described it as a tree of 5 m. He also collected it in forest at Kanosia nearly at sea-level and again described it as a tree only 5 m high. I feel convinced that the material all belongs to the same species and it is of course possible that CARR's specimens came from young trees. The ecological data clearly need verification.

**49. *Terminalia capitulata* EXELL, Blumea 7 (1953) 322.**

Tree 17 m by 120 cm; crown wide-spreading. Bark thick, black, scaly, rough. Young branchlets rufous-sericeous. *Leaves* subcoriaceous, spirally arranged and more or less crowded towards the ends of the branchlets, at first densely rufous-sericeous becoming sparsely sericeous-pilose on both surfaces, conspicuously and rather densely minutely verruculose above, rather inconspicuously so beneath, pellucid-punctate, obovate, 1½–4½ by 0.7–2.6 cm, usually rounded at the apex and cuneate at the base; nerves 5–7 pairs, with domatia in their axils; petiole rufous-sericeous, 3–7 mm. *Flowers* white, sessile, in 3–6-flowered pseudo-capitulae with peduncle up to 4 cm long provided with 2–3 bracts, 2–3 mm long, at the apex. *Lower receptacle* (ovary) rufous-sericeous, 1½–2 mm long; upper receptacle scarcely developed. *Calyx*-lobes rufous-sericeous outside, glabrous inside, triangular or ovate-triangular, acute, 2 mm long. Filaments glabrous, 2 mm; anthers 0.3 mm long. Style glabrous, 2 mm. *Fruit* unknown.

*Distr. Malaysia:* W. New Guinea (Balim River). Fig. 30.

Ecol. Primary forest on river bank, 1600 m.

*Note.* The structure of the inflorescence is very unusual in *Terminalia*.



50. *Terminalia oxyphylla* MIQ. Fl. Ind. Bat. Suppl. (1860) 326; SLOOT. Bijdr. Combret. (1919) 21; Bull. Jard. Bot. Btzig III, 6 (1924) 41.

Tree. Leaves membranaceous (young) crowded at the ends of the branches, glabrous, not verruculose, narrowly elliptic, narrowly obovate-elliptic or oblanceolate, 8–20 by 3–6½ cm, acuminate at the apex, cuneate at the base; petiole 4 cm long, without glands. Flowers and fruits unknown.

Distr. Malaysia: Sumatra (W. Coast).

Note. Only known from the type gathering, TEYSMANN 850 (BO, L, U); leaves only.

#### Cultivated species

The following species are cultivated in various Malaysian gardens: *T. arjuna* (ROXB.) W. & A., *T. chebula* RETZ. and *T. fatraea* (POIR.) DC. The latter species, owing to mis-identification, is variously referred to in the literature as *Bucida buceras*, *Bucida nitida* and *T. nitida*.

Wood anat. *T. chebula* RETZ.: PEARSON & BROWN, Comm. Timb. 1 (1923) 509; (*T. arjuna* BEDD.) PEARSON & BR. p. 516.

#### Excluded species

*Terminalia magarapali* VIDAL, Sinops. Atl. (1883) 26, t. 48, f. c; MERR. Philip. J. Sc. C. Bot. 4 (1909) 643; En. Philip. 3 (1923) 151.

### 4. CALYOPTERIS

LAMK, Ill. Gen. (1791–6) t. 357; Tabl. Enc. 2 (1819) 485.—*Getonia* ROXB. Pl. Corom. 1 (1798) 61, t. 87.

Scandent shrubs. Leaves opposite or subopposite. Flowers ♀, 5-merous, shortly pedicelled or subsessile in terminal leafy panicles. Receptacle (calyx-tube) divided into a lower part (*lower receptacle*) surrounding and adnate to the ovary and an upper campanulate part (*upper receptacle*) containing the disk and bearing the stamens. Calyx-lobes 5, accrescent. Petals 0. Stamens 10, biseriate, inserted within the upper receptacle above the margin of the disk; anthers versatile. Disk cupular without free margin. Style subulate. Ovary with 3 pendulous ovules of which one often aborts at an early stage and another aborts later. Fruit 5-gonous and 5-furrowed, crowned by the 5 spreading, accrescent calyx-lobes. Seed solitary.

Distr. Monotypic, India, Assam, Burma, Indo-China, Siam, and the Malay Peninsula.

Note. The question of priority between *Calycopteris* LAMK and *Getonia* ROXB. has long been a cause of instability in the nomenclature of this genus. LAMARCK's tab. 357 in his 'Illustrations des Genres' is still of uncertain date but was published not later than 1796 and probably about 1793–4. This plate seems to validate the genus although the corresponding text was not published until 1819. As long as ROXBURGH's *Getonia* appeared to have the firm date of 1795 it still seemed better to accept this name in view of the uncertainty about the date of *Calycopteris*; but W. T. STEARN now assures me that he has conclusive evidence (cf. p. ccx) that ROXBURGH's 'Plants of the [Coast of Coromandel]' was published in parts and that *Getonia* did not appear until 1798, later than any possible date for *Calycopteris*.

1. *Calycopteris floribunda* (ROXB.) LAMK, Enc. Méth. Bot. Suppl. 2 (1811) 41; Tabl. Enc. 2 (1819) 485; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 449; KING, J. As. Soc. Beng. 66, 2 (1897) 333; GAGNEP. Fl. Gén. I.-C. 2 (1920) 769, f. 79; RIDL. Fl. Mal. Pen. 1 (1922) 706; CRAIB, Fl. Siam. En. 1 (1931) 610; BURK. Dict. (1935) 416.—*Getonia floribunda*

\* There is no type in existence. MERRILL (l.c. 1923) considers that it may be *Elaeocarpus monocera* CAV. (*Elaeocarpaceae*).

*Terminalia quadrialata* MERR. Philip. J. Sc. C. Bot. 4 (1909) 301 = *Combretodendron quadrialatum* (MERR.) MERR. (*Lecythidaceae*).

*Terminalia trinervia* K. SCHUM. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 466 = *Bennettia trinervia* (K. SCHUM. & LAUT.) GILG (*Flacourtiaceae*).

*Terminalia vernix* LAMK, Encyc. Méth. 1 (1783) 350.—*Arbor vernicis* RUMPH. Herb. Amb. 2: 259, t. 86, according to MERR. Int. Herb. Amb. (1917) 331 = *Gluta renghas* L. ('benghas') (*Anacardiaceae*). *T. angustifolia* JACQ., an illegitimate name-change for *Croton bentzoe* L. (= *Terminalia bentzoe* (L.) L. f.), has been confused with this species (see MIQ. Fl. Ind. Bat. 1, 1, 1885, 599 and SLOOT. Bull. Jard. Bot. Btzig III, 6, 1924, 42).

#### Insufficiently known species

*Terminalia amboinensis* HORT. ex STEUD. Nomencl. ed. 2, 2 (1841) 668, *nomen nudum*.

*Terminalia curranii* MERR. ex E. E. SCHNEIDER, Bull. Bur. For. Philip. no 14 (1916) 197, *nomen nudum*. This is said 'to be known from one specimen from Laguna; no wood specimen present'. No type has been seen; it may represent possibly either *T. nitens* PRESL. or *T. foetidissima* GRIFF.

ROXB. Pl. Corom. 1 (1798) 61, t. 87; EXELL, J. Bot. 69 (1931) 127.—*C. nutans* KURZ, J. As. Soc. Beng. 46 (1877) 59; For. Fl. Burm. 1 (1877) 368.—Fig. 1e.

Large scandent shrub. Young branchlets densely fulvous-tomentellous. Leaves chartaceous densely fulvous-pubescent above when young, somewhat glabrescent when older, densely fulvous-tomentel-

lous below, finely reticulate, ovate to narrowly elliptic 6–17 by 2–7 cm, usually acuminate or acute at the apex, cuneate, rounded or subcordate at the base; petiole  $1\frac{1}{2}$ –1 cm, fulvous-tomentellous. *Panicle* with reduced leaves at the points of branching and narrowly elliptical tomentellous leaf-like bracts, 10–11 by 4–4 $\frac{1}{2}$  mm, subtending the flowers. *Flowers* yellowish-green. Lower receptacle fulvous-villous, 4 $\frac{1}{2}$  by 2 mm. Upper receptacle fulvous-villous both within and without, 3 by 4 $\frac{1}{2}$  mm. *Calyx*-lobes narrowly elliptic or oblanceolate fulvous-sericeous-tomentellous 4 by

2 mm, in fruit reaching a length of 1–1 $\frac{1}{2}$  cm. Filaments 2 $\frac{1}{2}$  mm; anthers 0.6 mm long. Style 5 mm, pilose except at the apex. *Fruit* ellipsoid, densely villous, 7–8 by 2–3 mm.

*Distr.* SE. Asia, in *Malaysia*: Malay Peninsula (Penang & Langkawi Islands, Pahang); also in Lower Siam.

*Ecol.* A climber in mixed forests and along river-banks.

*Uses.* The flowers are used in Penang as a poultice for head-aches.

*Vern.* *Pĕlawas*, M.

## 5. LUMNITZERA

WILLD. Neue Schr. Ges. Naturf. Fr. Berl. 4 (1803) 186; SLOOT. Bijdr. Combr. (1919) 26; Trop. Natuur 11 (1922) 54, 65; Bull. Jard. Bot. Btzig III, 6 (1924) 43; Blumea Suppl. 1 (1937) 162; EXELL, J. Bot. 69 (1931) 128.—*Pyrrhanthus* JACK, Mal. Misc. 2, no 7 (1822) 57.

Small, evergreen, trees or shrubs. *Leaves* spirally arranged, sessile or almost sessile, fleshy-coriaceous, entire, glabrous when mature. *Flowers* ♂, 5-merous, actinomorphic, red, white, pink or yellow, in short terminal or axillary spikes or racemes. *Receptacle* (calyx-tube) not externally differentiated into an upper and a lower part but produced to form a tube beyond the ovary, bearing two adnate persistent bracteoles and terminating in a 5-lobed persistent *calyx*. *Petals* caducous. Stamens 5–10 borne on the inner wall of the receptacle tube; anthers versatile. Disk absent or inconspicuous. Ovules 2–5; style filiform, persistent, not adnate to the wall of the receptacle; stigma simple. *Fruit* (pseudocarp) compressed-ellipsoid, obtusely angled, more or less woody, crowned by the persistent calyx.

*Distr.* Species 2: one in E. Africa, Madagascar, tropical Asia, *Malaysia*, N. Australia, and Polynesia, the other in tropical Asia, *Malaysia*, N. Australia and Polynesia.

*Ecol.* Small trees or shrubs of mangrove swamps, tidal rivers, and estuaries, mostly on the land side of the mangrove, often above flood level.

VAN BODEGOM asserts (*in litt.*) that *Lumnitzera* forms a definite *téruntum* mangrove type (girdle) occupying the back-mangrove on solid, drier soils which are sandy or have a sandy subsoil. He observed

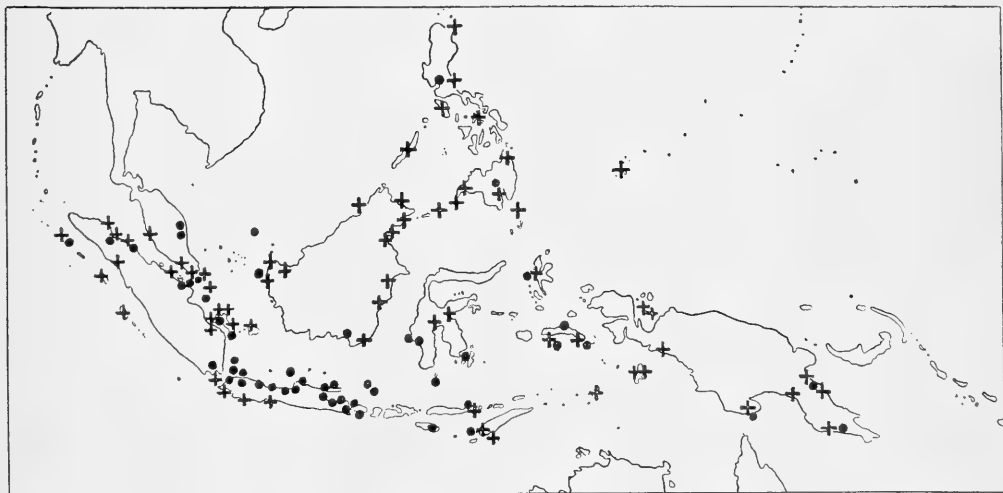


Fig. 31. Distribution of *Lumnitzera racemosa* WILLD. (●) and *L. littorea* (+) in Malaysia.

*Lumnitzera* to be frequent in the Riouw Islands but less so on the muddy shores of Bengkalis except on the more sandy northern shores of the islands, where they may form pure stands as e.g. on the N. bank of Sg. Kembung. Similar observations were made by VAN DER ZWAAN (Het Bosch 2, 1934, 160) for Indragiri; exceptional trees may reach 40 m by 60–70 cm there. DE HAAN (Tect. 24, 1931, 51) found *Lumnitzera* in Tjilatjap (S. Java) forming part of his type 8 in girdle A4, characterized by solid shallow soils with local marlbanks below, inundated yearly only during very few days. Along Djakarta Bay *Lumnitzera racemosa* is locally gregarious in the back-mangrove. VAN DIJK (Boschbedrijf etc., 1939, 55) found *Lumnitzera* gregarious in the Island of Meos Noem (Geelvink Bay).

According to VAN SLOOTEN (Trop. Natuur 11, 1922, 54, 65, map; Bull. Jard. Bot. Btzg III, 6, 1924, 43–49, map; Blumea Suppl. 1, 1937, 162–175, map) the two species, though occurring throughout Malaysia where their areas overlap, practically exclude each other in habitat, and have never been collected in exactly the same stand. *L. littorea* appears to be entirely absent from the shores of the (muddy) Java Sea where in contrast *L. racemosa* has numerous stations. The exact cause of this different ecological behaviour is not yet known.

Wood anat. See under the species.

Uses. The timber is valuable; see under the species.

#### KEY TO THE SPECIES<sup>1</sup>

1. Flowers red, shortly pedicellate. Stamens twice as long as the petals. Inflorescences terminal. Knee-shaped pneumatophores usually present . . . . . **1. *L. littorea***
1. Flowers white (occasionally pink?) or yellow (in *var. lutea*), sessile. Stamens equalling or only slightly exceeding the petals. Inflorescences axillary. Knee-shaped pneumatophores absent. **2. *L. racemosa***

**1. *Lumnitzera littorea*** (JACK) VOIGT, Hort. Suburb. Calc. (1845) 39; KURZ, For. Fl. Burm. 1 (1877) 469; MERR. Philip. J. Sc. C. Bot. 4 (1909) 647; En. Born. (1921) 423; En. Philip. 3 (1923) 153; W. H. BROWN, Minor Prod. Philip. For. 1 (1920) 68, t. 30; SLOOT, Bull. Jard. Bot. Btzg III, 6 (1924) 43; HEYNE, Nutt. Pl. N.I. (1927) 1178; H. J. LAM, Miangas (1932) 29, 59; CORNER, Wayside Trees (1940) 191; MEEUSE in BACKER, Fl. Jav. (em. ed.) 4, fam. 101 (1944) 8.—*Pyrrhanthus littoreus* JACK, Mal. Misc. 2, no 7 (1822) 57.—*Laguncularia purpurea* GAUD. in FREYC. Voy. Bot. (1826) 481, t. 104.—*L. purpurea* PRESL, Rep. Bot. 1 (1834) 155.—*L. coccinea* W. & A. Prod. (1834) 316; MIQ. Fl. Ind. Bat. 1, 1 (1857) 606; CLARKE in HOOK. f. Fl. Brit. Ind. 2 (1878) 452; KING, J. As. Soc. Beng. 66, 2 (1897) 334; FERN.-VILL. Novis. App. (1880) 80; VIDAL, Rev. Pl. Vasc. Filip. (1886) 128; KOORD. Exk. Fl. 2 (1912) 672; RIDL. Fl. Mal. Pen. 1 (1922) 707; BURK. Dict. (1935) 1372.— **Fig. 32, 33.**

Tree up to c. 25 m by 50 cm, mostly smaller, not buttressed, with slender knee-shaped pneumatophores. Bark dark brown, fissured, inner bark reddish-brown, sapwood yellowish-brown, heartwood dark brown. Young branchlets reddish or grey, glabrous. *Leaves* usually crowded at the ends of the branchlets, narrowly obovate-elliptic, 2–8 by 1–2½ cm, rounded at the apex and cuneate at the base, with rather obscure marginal glands. Racemes short, terminal, c. 1½–3 cm long. *Flowers* red, shortly (1–1½ mm) pedicelled. *Receptacle* glabrous, tubular or narrowly infundibuliform, laterally compressed, slightly constricted just below the apex and then expanded into the calyx, 8–10 mm long, with two small, ovate, ciliate bracteoles ½–¾ mm long, adnate to it usually just below its middle. *Calyx*-lobes very broadly ovate, c. 1 mm long, slightly imbricate, margin

ciliate. *Petals* red, glabrous, oblong-elliptic, 4½ by 1½–2 mm. Stamens 5–10, c. 10 mm long, double the length of the petals. Style 10 mm, glabrous. *Fruit* glabrous, c. 10 by 4 mm longitudinally ribbed, somewhat corky in texture with a very thin inner layer of sclerenchyma and some strands of sclerenchymatous tissue dispersed throughout the pericarp.

Distr. Tropical Asia, northern Australia, and Polynesia, throughout *Malaysia* but apparently absent or very rare on the coasts of the Java Sea, where it is replaced by *L. racemosa*.

Ecol. Generally a small tree, mostly of the back-mangrove, sometimes gregarious, also above the tide level.

Wood anat. (*L. coccinea*) MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 378; REYES, Commonw. Philip. Dept Agr. Techn. Bull. 7 (1938) 365.

Uses. Wood dark grey; timber hard, durable, fine-grained, keeps its shape remarkably well; when first cut it has the scent of roses. Suitable for bridges, wharf-building, axles of carts, flooring, tool-handles, furniture, sleepers, ship-building, etc. but difficult to obtain in large pieces. Repeatedly recorded as sound for pier-posts standing seawater conditions, especially if the bark is not removed.

Vern. *Tēruntum*, *tēruntum merah*, M, *api-api* uding, Simalur, *gëriting*, W. Borneo, *randai*, E. Borneo, *riang laut*, Banka, *sēsop*, *sēsak*, Sum. E.C., *taruntung*, S, *duduk agung*, *duduk gëdeh*, J, *wēlom-pēlong*, Bugin., *tēnē*, Roti, Timor, *post-posi ma gorago*, Ternate; Philippines: *tabau* (standard name), *agnáa*, *anilai*, *libato*, *kulasi*, *libatu-pulá*, *dalúru-babáe*, *papasil*, Tag., *aguia*, *kalapini*, Sbl., *bakting*, *banting*, *bating*, *panting-panting*, *santing*, Sul., *bulok-bulok*, *salasa*, P. Bis., *dulok-dulok*, Bis., *sagasa*, *maoro*, C. Bis., *karifurog*, Neg., *linas*, Bag., *magalólo* Tagb., *supsupun*, Tagk., *talau*, Bik.

(1) See also the notes sub. *L. littorea*.



Fig. 32. *Lumnitzera littorea* (JACK) VOIGT. *a.* Flowering twig, nat. size, *b.* flower,  $\times 2$ , *c.* rachis with fruits,  $\times 2$ .

Notes. It is not always easy to distinguish *L. littorea* from *L. racemosa* from deficient or disintegrated herbarium material. From leaves alone I doubt whether a confident determination can be given (at least without anatomical investigation). Attention to the following points will, however, enable most specimens to be named:

(*a*) When well preserved flowers are available there is no difficulty. Those of *L. littorea* are red with stamens twice as long as the petals: those of *L. racemosa* are white (rarely pink or yellow)

with stamens approximately equalling the petals. (*b*) With old flowers or young fruits two features should be noted: (i) the flowers are shortly pedicellate in *L. littorea* and sessile in *L. racemosa* (but it is not always easy to decide); (ii) in *L. littorea* the adnate bracteoles are merely very small appendages which do not interfere much with the general outline of the receptacle (calyx-tube). They are subopposite and usually attached somewhat below the middle of the receptacle. In *L. racemosa* the bracteoles are distinctly larger



Fig. 33. *Lumnitzera littorea* (JACK) VOIGT. Lukut Forest Reserve, Port Dickson, Malay Peninsula (WYATT-SMITH).

and interfere more fundamentally with the general outline of the receptacle (see fig. 1, b). They are often attached at different levels, sometimes one above and one below the middle of the receptacle. (c) Older fruits, where characters mentioned in (b) become less evident, are said to be distinguishable in cross-section. In *L. racemosa* there is a well-developed inner layer of sclerenchyma with regular, radial, spoke-like projections. In *L. littorea* the pericarp looks more uniform and somewhat corky in structure with irregularly dispersed strands of sclerenchyma and only a very narrow band of sclerenchyma surrounding the seed-cavity. But this distinction is not always as clear as it sounds.

(d) In the complete absence of flowers and fruits, if the rachis of the inflorescence remains and appears rather stout and clearly terminal the specimen is *L. littorea*.

(e) If the buds and very young branchlets are appressed-pubescent the specimen is *L. racemosa*, but a glabrous specimen is not necessarily *L. littorea*.

(f) Any trace of pubescence on the leaves also indicates *L. racemosa* but care must be taken not to be misled by mould.

**2. *Lumnitzera racemosa* WILLD.** Neue Schr. Ges. Naturf. Fr. Berl. 4 (1803) 187.—Fig. 1, b.

Small tree, up to c. 8 m by 30 cm, or shrub; knee-shaped pneumatophores absent. Bark rough, reddish-brown. Young branchlets reddish or grey,

sometimes appressed-pubescent at first, soon glabrous. Leaves pubescent or glabrous, narrowly obovate, narrowly obovate-elliptic or narrowly elliptic, 2–9 by 1–2½ cm, blade cuneate to the subsessile base or sometimes narrowed 5–8 mm above the base thus appearing sub-petiolate. Spikes short, axillary, c. 2 cm long. Flowers white (rarely pink?) or yellow (in var. *lutea*), sessile. Receptacle tubular or narrowly urceolate, laterally compressed, glabrous or pubescent, 6–8 mm long, usually contracted just above the middle at the insertion of the two broadly ovate, 1½ mm long, sometimes ciliate, opposite or subopposite adnate bracteoles. Calyx-lobes broadly ovate-acuminate often gland-tipped, sometimes with 3 glands, sometimes glandless, 4/5–1 mm long. Petals white (? sometimes pink) or yellow, glabrous, narrowly elliptic or oblanceolate, 4 by 1 mm. Stamens 10, equalling or slightly exceeding the petals. Style 6–7 mm long, glabrous. Fruit appressed-pubescent or glabrous, 10–12 by 3–5 mm; pericarp with a well-developed inner layer of sclerenchyma extended radially giving a spoke-like appearance in cross-section.

Distr. Eastern tropical Africa, Madagascar, tropical Asia, northern Australia and Polynesia, throughout Malaysia but almost absent from the shores facing the Indian Ocean.

Ecol. Small tree or shrub of mangrove swamps. According to HASKARL (Nat. Tijds. N.I. 10, 1856, 170) and TEYSMANN (*op. cit.* 14, 1857, 368) it has been grown in occasionally (freshwater)-flooded

sandy soil in the Buitenzorg Botanical Garden, where it has flowered and fruited.

Wood anat. (*L. racemosa* & *L. racemosa* var. *pubescens*) MOLL & JANSSONIUS, Mikr. Holzes 3 (1914) 382 & 383.

Uses. The timber is similar in quality to that of the preceding species, but dimensions are generally even smaller. The bark is sometimes used for tanning purposes.

Vern. *Tēruntum bunga puteh*, Mal. Pen., *api-api balah*, Simalur, *duduk laki-laki*, Lampongs, *api-api djambu*, S. Borneo, *duduk, t(ě)runum*, J, *adu-adu*, Md, *knias*, Samau; Philippines: *kulási* (standard Tagalog name), *solási*, Tag., *tabau*, P. Bis., Tag., *agnáya*, Sbl.

#### KEY TO THE VARIETIES

1. Flowers white (rarely pink?) var. **racemosa**  
1. Flowers yellow (Timor) . . . var. **lutea**

var. **racemosa**.—*L. racemosa* WILLD. in Neue Schr. Ges. Naturf. Fr. Berl. 4 (1803) 187; SPANOGHE, Linnaea 15 (1841) 203; MIQ. Fl. Ind. Bat. 1, 1 (1855) 606; SCHEFFER, Ann. Jard. Bot. Btzig 1 (1876) 23; KURZ, For. Fl. Burma 1 (1877) 468; CLARKE in HOOK. f. Fl. Br. Ind. 2 (1878) 452; KING, in J. As. Soc. Beng. 66, 2 (1897) 334; KOORD. & VAL. Bijdr. Booms. 9 (1903) 33; MERR. Philip. J. Sc. C. Bot. 4 (1909) 647; EN. Born. (1921) 423; EN. Philip. 3 (1923) 154; KOORD. Exk. Fl. 2 (1912) 672; SLOOT. Bijdr. Combr. (1919) 28; Bull. Jard. Bot. Btzig III, 6 (1924) 46; GAGNEP. Fl. Gén. I.-C. 2 (1920) 772; RIDL. Fl. Mal. Pen. 1 (1922) 707; HEYNE, Nutt. Pl. N.I. (1927) 1178; CRAIB, Fl. Siam. En. 1 (1931) 621; BURK. Dict. (1935) 1373; CORNER, Wayside Trees (1940) 191; MEEUSE in BACKER, Fl. Jav. (em. ed.) 4, fam. 101 (1944) 8.—*Laguncularia rosea* GAUD. in FREYC. Voy. Bot. (1826) 481, t. 105, f. 2.—*L. rosea* PRESL,

Rep. Bot. 1 (1834) 155.—*Petaloma alba* BLANCO, Fl. Filip. (1837) 344.—*L. racemosa* var. *pubescens* KOORD. & VAL. Bijdr. Booms. 9 (1903) 34.

Distr. etc. As for the species.

Note. The typical variety with white flowers [perhaps occasionally pink—see *L. rosea* (GAUD.) PR.]. There is little doubt that *L. rosea* was described from the common combretaceous mangrove in Manila Bay, which is *L. racemosa*. I have seen no other reference to a pink-flowered form.

var. **lutea** (GAUD.) EXELL, comb. nov.—*Laguncularia lutea* GAUD. in FREYC. Voy. Bot. (1826) 481, t. 105, f. 1; DECNE in Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 458; MIQ. Fl. Ind. Bat. 1, 1 (1855) 606.—*L. lutea* PRESL, Rep. Bot. 1 (1834) 156; SLOOT. Bijdr. Combr. (1919) 30; Bull. Jard. Bot. Btzig III, 6 (1924) 49; Trop. Natuur 17 (1928) 136; Blumea Suppl. 1 (1937) 173.

Distr. *Malaysia*: Lesser Sunda Islands (Timor: Bay of Koepang between Kp. Oël Hendak and Pitais and near Kp. Babao; P. Alor: near Kp. Kakilai opposite Kalabahi).

Ecol. Small tree of the mangrove formation in tidal forest.

Note. A yellow-flowered variety with gland-tipped calyx-lobes. While it was thought that the yellow flower-colour and gland-tipped calyx-lobes in association were characters distinguishing *L. lutea* from *L. racemosa* there was justification for maintaining them as separate species; but gland-tipped calyx-lobes are to be found in the white-flowered variety, especially in New Guinea and the Philippines. *L. racemosa* var. *racemosa* has been recorded from Timor (although I cannot verify the flower-colour and the specimens are now without flowers) so that var. *lutea* is apparently not geographically isolated from the type variety.



# ADDENDA, CORRIGENDA ET EMENDANDA

It seemed useful to correct some errors which have crept into the text of volume 4 as well as to add some additional data which came to our knowledge and are worth recording. Valuable help in general was rendered by Dr R. C. BAKHUIZEN VAN DEN BRINK *Jr*, for additions to the *Burmanniaceae* by Dr F. P. JONKER, for *Chenopodiaceae* by Dr C. A. BACKER, for *Viburnum* by Mr J. H. KERN, for *Xyris* by Dr P. VAN ROYEN, and for a grass by Dr P. JANSEN. Printing errors have only been corrected if they may give rise to confusion.

The page numbers *a* and *b* denote respectively the left and right column.

Page:		xxivb	An additional curious example of dimorphous fruits is that of <i>Vigna hoesi</i> (CRAIB) BACKER ( <i>V. oligosperma</i> BACKER, <i>Dolichos hoesi</i> CRAIB). Cf. BACKER & VAN SLOOTEN, Geïllustr. Handb. Jav. Theeonkr. (1924) 153; BACKER, Bekn. Fl. Jav. (em. ed.) 5 (1941) 153. Aerial fruits differ distinctly from those produced by flowers which are hidden in the litter of leaves covering the soil.
xviiib	The <i>Clausena</i> of unknown origin has proved to belong to <i>C. anisata</i> (WILLD.) HOOK. f. (syn. <i>C. inaequalis</i> BTH.).		
xviiiib	Last sentence of 2nd paragraph to be changed into: e.g. when HALLIER pointed to the desirability of phytochemical investigation as to the presence of valerician acid in <i>Viburnum</i> . <sup>5</sup>		
xviiib	Last line of footnote read: Cf. also <i>V. valerianicum</i> ELM.	xxviiia	End of paragraph 2: the correct name for the Malaysian ' <i>Erigeron linifolius</i> WILLD.' is: <i>E. sumatrensis</i> RETZ.
xxa	The <i>Tristania</i> of fig. 2 had been named specifically <i>T. bakhuizeni</i> BACK. (Blumea 5, 1945, 502).	xxviiia-b	The grass figured in fig. 11 is rightly <i>Isachne kinabaluensis</i> MERR., a species very closely allied to (or possibly only a race of) <i>I. pangerangensis</i> Z. & M.
xxa	<i>Macrozanonia</i> is now named <i>Alsomitra</i> (BL.) ROEM. Cf. HUTCHINSON, Ann. Bot., new ser., 6 (1942) 96-102 and DE WIT, Bull. Bot. Gard. Btzg III, 18 (1949) 193-200.	xxviiiia	Last line of paragraph 2: omit '(L.)' in the authority of <i>Dodonaea viscosa</i> JACQ. The combination is not based on <i>Ptelea viscosa</i> L.
xxia	Line 4 below fig. 4 read instead of ' <i>picta</i> ': <i>pictus</i> .	xxxiiia	Line 11 from bottom: omit '(BL.)' from the authority of <i>Weinmannia blumei</i> PLANCH.
xxia	Paragraph 5: The late Dr ENDERT found in Sumatra long needles on a 50 m tall tree of <i>Dacrydium</i> and maintains it to represent a separate species; cf. Tectona 18 (1925) 62. However, this should be examined more closely; there might be a dimorphy of the foliage.	xxxiiib	Line 5 from top: replace <i>Dianella nemorosa</i> LAMK by the earlier name <i>D. ensifolia</i> L. which SCHLITTLER erroneously placed in the synonymy.
xxib	Paragraph 3: According to Mr BLAKELOCK, Kew, the climbing form of <i>Evo-nymus</i> in Java represents <i>E. fortunei</i> (TURCZ.) HAND.-MAZZ. (cf. Kew Bull. 1951, 268).	xxxva	An other example of phytomorphosis is that in <i>Leersia hexandra</i> Sw. No fruit is set in Malaysia but the ovary is sometimes attacked by a fungus ( <i>Testicularia leersiae</i> CORNU) which causes the ovary to expand by which it resembles a grain. Cf. VAN OVEREEM (Teysmannia 33, 1922, 395) and BACKER (Handb. Fl. Jav. pt 2, 1928, 195, footnote).
xxib	Line 4 of § 2 replace ' <i>arguata</i> ' by: <i>arguta</i> .		
xxib	<i>Ditto</i> line 17 to be replaced by: <i>Coffea canephora</i> PIERRE var. <i>robusta</i> CHEV., <i>Citrus maxima</i> L.	xxxva	Change in legend to fig. 26 <i>Epichloe treubii</i> into: <i>Epichloe bambusae</i> PAT.
xxiia	Second paragraph: the correct name of the dwarf <i>Cananga</i> seems to be: <i>Cananga odorata</i> (LAMK) HOOK. f. & TH. var. <i>fruticosa</i> (CRAIB) SINCLAIR; cf. Sarawak Mus. J. no 18 (1951) 599.	xxxva	Alinea 2 from bottom: the correct name for <i>Pilea trinervia</i> WIGHT seems to be <i>P. melastomatoides</i> (POIR.) BL.
xxiib	Paragraph 2: it may be that <i>Argostemma unifolium</i> BENN. from the Malay Peninsula which shows a habit similar to that of <i>Monophyllaea c.s.</i> , belongs to the same category.	xxxvb	In 2nd line of legend of fig. 27 replace 'galled swollen fruit' by: bark-gall.
xxiib	Third line from base replace ' <i>angusta</i> ' by: <i>augusta</i> .	xxxvia	Replace 2nd paragraph of sect. 20 by: <i>Kibessia sessilis</i> BL. is merely the galled state of <i>K. azurea</i> BL. (fig. 27); cf. DOCTERS VAN LEEUWEN, Bull. Jard. Bot. Btzg III, 1 (1919) 131-135.
xxiib	Second line from base: The correct writing of the Rutaceous genus seems to be <i>Lavanga</i> , not ' <i>Luvunga</i> '.	xxxvia	Paragraph 8: not BOERLAGE, but BAKHUIZEN VAN DEN BRINK Jr (in MS) supposed the relationship between <i>Otopetalum</i> and <i>Micrechites</i> .
xxiia	Other genera with dimorphous leaves or leaflets are <i>Arthrophyllum</i> and <i>Pterospermum</i> .	xxxviiia	Paragraph 2: the correct name for the common ' <i>Ziziphus jujuba</i> L.' is <i>Z. mauritiana</i> LAMK.
xxiib	In legend of fig. 8 read <i>Uria</i> instead of ' <i>Uvaria</i> '.	xliia	Second line of 14th paragraph from top first letter should be: G.



- xlvia Last line of legend to fig. 34, replace 'genuina' by: *borneensis*.
- xlviib Line 8 from top, omit '(4)'.
- xlviib Fourth line of 4th paragraph add after 'family': (4).
- xlviib & xlixa My preliminary identification of the Sumatran '*Schima brevifolia* HOOK. f.' was wrong, according to Dr BLOEMBERGEN (Reinw. 2, 1952, 178); the specimens being probably referable to *Gordonia* or *Laplacea*. Therefore, its name should be omitted as an example of the altitudinal distribution behaviour alluded to.
- xlixa In the figure the altitudinal figures should start with 900 and those printed should be each lifted one line.
- lb Line 16 from bottom '(1925)' should be: (1928).
- liiia For a more detailed map of *Hibbertia* see p. 150.
- lxxva Second line of 2nd paragraph read: GARCIA DA ORTA.
- clb Second line of 3rd paragraph read instead of Wilhelmina Mts: summit of Mt Doorman.
- clib Paragraph 5, line 6, last letter should read: C.
- cxxx-clvii In 1950 Dr F. H. ENDERT rightly drew my attention to the fact that DE WIT has entirely failed to give an adequate evaluation of the astounding botanical work accomplished by forest services generally and the Bogor Forestry Institute in particular. Invaluable papers on forest composition contained in the journal 'Tectona' by ENDERT and others have only partially been given attention, while on the other hand trivial and sketchy papers of amateurs were duly recorded. This makes the whole treatment of chapters 80 onwards distinctly unbalanced. I had in mind asking Dr ENDERT to write an entirely new essay devoted solely to the work accomplished by the Forestry Research Institute at Bogor, as a re-writing of the chapters is out of question. Unfortunately Dr ENDERT died early in 1953 and I can find nobody to perform this task.
- 3 Unfortunately it has appeared that the name *Acer niveum* BL., an almost consistently used new combination for *Acer javanicum* JUNGH. non BURM., is not the correct name for this species, apart from the question whether it is conspecific with the earlier *A. oblongum* WALL., which is here not considered. A careful scrutiny of the nomenclatural value and exact dates of the references showed that the correct name is *A. laurinum* HASSK. The essential synonymy, which should replace the one given on page 1, is as follows:  
**1. *Acer laurinum* HASSK. in HOEVEN & DE VRIESE, Tijds. Nat. Geschied. & Phys. 10 (1843) 138; Cat. Hort. Bog. (Oct. 1844) 222;**  
 Flora 30 (28 Aug. 1847) 518; MIQUEL, Fl. Ind. Bat. 1, 2 (1859) 582, Suppl. (1860-61) 200, 511.—*A. javanicum* JUNGH. [in HOEVEN & DE VRIESE, Tijds. Nat. Geschied. & Phys. 8 (1841) 391, *nomen nudum*] Monatsber. Verh. Ges. Erdkunde Berlin 3 (Jan. 1842) 96, *descr.*; Topogr. & Naturw. Reisen Java (1845) 390, *descr.*, 434; non *A. javanicum* BURM. f. Fl. Ind. (1768) 221.—*A. niveum* BL. Jaarb. Kon. Ned. Mij Aanmoedig. Tuinbouw over 1844 (issued later than May 1845 and eventual reprints in each case posterior to Oct. 1844, cf. footnote on p. 84!); Rumphia 3 (1847) 193.—*A. cassiae-folium* BL. Rumphia 3 (1847) 193.—*A. philippinum* MERR. Govt Lab. Publ. no 35 (1906) 36.—*A. curranii* MERR. Philip. J. Sc. 4 (1909) Bot. 285.  
 4 Add to distribution of *A. laurinum* HASSK.: Timor.  
 7 Add to distribution of *Helmholtzia novoguineensis*: Jappen Island (Sarurai pr. Serui, AET & IDJAN 22).  
 8 The correct authority for *Ancistrocladus* is: *Ancistrocladus* WALL. [Cat. (1832) 1052] ex WIGHT & ARNOTT, Prod. 1 (1834) 107, *nom. cons.*  
 8 Line 12 from bottom read instead of 'Hugoniaceae': *Hugonieae*.  
 9b *Ancistrocladus tectorius* has recently been collected in East Borneo (Sg. Wain, pr. Balikpapan, KOSTERMANS 4315, flowers red or dull white, stalks of inflorescence reddish).  
 10b Line 2 from bottom, add after WALL.: (Cat. 10557) ex DC. Prod. 16<sup>2</sup> (1868) 603.  
 12b Besides the BRASS-specimens of *Aponogeton loriae* I saw several others from New Guinea: CHALMERS a. 1885; Sugairee, ARMIT a. 1883; Oriomo River, GIULIANETTI a. 1897).  
 15 Add in the key:  
 13a. Outer perianth lobes obovate, fleshy in the upper part. Inner lobes linear to oblanceolate, almost 1 mm long. Connective with 2 apical divergent, acute crests. Flower-wings broad, half-rhomboid to half-cuneate.  
**13a. *B. candida***  
 13a. Outer perianth lobes triangular obtusely apiculate, with thick, fleshy margin, not fleshy in the upper part. Inner lobes orbicular or lanceolate, often minute. *Proceed to 14.*  
 18a Add to 2nd paragraph (distribution of *B. championii*): Moluccas (W. Ceram, Biv. iii-Horale, N of summit G. Lumut, alt. 460 m. April 1938, EYMA 3196).  
 19a Insert before 14. *Burmannia lutescens*:  
**13a. *Burmannia candida* GRIFF. ex HOOK. f. Fl. Br. Ind. 5 (1888) 665; JONKER, Mon. Burm. (1938) 147; Fl. Mal. I, 1 (1938) 19b.—*B. candida* GRIFF. var. *coerulea* HOOK. f. ex WILLIAMS, Bull. Herb. Boiss. II, 4 (1904) 362.— non *B. candida* (BL.) ENGL.**

- Slender saprophyte, 6–16 cm high. *Stem* usually simple, only branched at the top into the inflorescence, 1–5-flowered, beset with small, reduced, scalelike, lanceolate, acute leaves, 2–5 mm long. Larger *leaves* often acuminate or subulate, sometimes imbricate in the lower stem part. Radical, rosulate, leaves lacking. Bracts similar to the stem scales, about 3 mm long. *Flowers* white or white with yellow or blue, 6–10 mm long, prominently 3-winged. *Outer perianth-lobes* about 2 mm long, obovate, obtuse, thick and fleshy in the upper part. Inner lobes erect, linear to oblanceolate, obtuse, almost 1 mm long. *Perianth-tube* cylindrical, slightly swollen in the upper part, about 4 mm long. Anthers sessile in the perianth-throat below the inner lobes. Connective oblong with two apical, acute, divergent crests, basal hanging spur lacking. Style filiform, bearing at its apex 3 subsessile, obconical to funnel-shaped stigmas. Style with stigmas about 4 mm long. Ovary obconical to obovoid, about 2.5 mm long. *Flower wings* 5–8 mm long and up to 4.5 mm broad, half-rhomboid to half-cuneate, running from the base of the limb to below the base of the ovary.
- Distr. Tenasserim (Amherst, Mergui), W. Siam (Koh Chang), Langkawi Islands (Terutau Isl.), and *Malaysia*: Central Sumatra (Indragiri, between S. Temberan to Sanglap, Oct. 15, 1939, 400 m alt., BUWALDA 7043).
- 19a Add to distribution of *Burmanna lutescens*: Central West Celebes (E of Lindu Lake, W. slope of Mt Njilalaki, c. 1000 m alt., July 1939, BLOEMBERGEN 4017; Central Celebes, Masamba, base of West spur of Mt Kambuno, 1400–1700 m, July 1937, EYMA 1283).
- 19b Add to first paragraph: and Sumatra.
- 20a It was said that *Gymnosiphon aphyllus* BL. occurred 'throughout Malaysia'. However, it was at that time (and with it the whole genus) not yet recorded from Sumatra, but it appears to have been found in Central Sumatra (Indragiri, Muara Padjanki, about sea-level, April 1939, BUWALDA 6455). The identification is not wholly certain as the specimen is in fruit.
- 23b Line 8 from top add: Tembeling, twice collected (CARR s.n., July 1929; CORNER 23829, Nov. 1930, type).
- 25a In the synonymy of *Geomitra clavigera* BECC. the reference to *Thismia clavigera* F.v.M. should read: Pap. & Proc. R. Soc. Tasm. for 1890 (1891) 235.
- 27 To the references of the genus *Sphenoclea* should be added: , *nom. cons.*—*Pongati* ADANS. Hist. Nat. Sénégal (1756), *ed. angl.* (1759) 152, *nom. rejic.*—*Pongatium* JUSS. Gen. (1789) 423.
- 27 First line: Date of DC. Prod. 8 is 1839, not '1939'.
- 28 In the legend under the figure 'A rich-flowered individual' should be replaced by: From an unpublished painting (c. 1820) probably from ROYLE or CAREY, in the Kew Herbarium.
- 32 Line 5, add after 322: LAM & VAN ROYEN, Blumea 7 (1952) 152.
- 32b The distribution of *S. paniculatum* is extended to include Central Celebes, Moluccas (Ceram), and the whole of New Guinea.
- 35a The page of description of *Stackhousia intermedia* is not '174' but: 281.
- 37 Third line, year of LINDL. Nat. Syst. ed. 2 is: 1835.
- 42b Add to Distr.: Moluccas (Aru Isl., Maikor, leg. BECCARI).
- 45 The authority for the genus *Moringa* should read: [BURM. Thes. Zeyl. (1737) 162, t. 75] ADANS. Fam. 2 (1763) 318; JUSS. etc.. Add at the end: PAX in E. & P. Pfl. Fam. ed. 2, 17b (1936) 693.—*Hyperanthera* FORSK. Fl. Aeg.-Ar. (1775) 67.
- 47a First line change '(1748)' into: 1784.
- 48b Line 12 from top, change the letter S. into *Saururopsis*.
- 51a Line 2 change '1837' into: 1838.
- Line 9 from bottom replace '287' by: 278.
- 54b In the 1st line of the 7th paragraph it should be: *f. inutile*.
- 57a Last line omit komma at the end.
- 61b Line 4 from bottom omit: (*gillevraei*) and add to line 5 *ditto* behind 106: (*gillivraei*).
- 62b Line 4 at end of line, change '552' into: 512.
- 64a Line below figure replace '*l.c.*; MIQ. *l.c.* 682' into: Bijdr. (1825) 243; MIQ. Fl. Ind. Bat. 1, 2 (1859) 682;
- 68 A second collection of *Torrenticola queenslandica* has turned up from SE. New Guinea: Brown River, CARR 12956, 100 m alt., 27.8.1935; this possesses also sterile shoots which I described and figured (of a 2nd Queensland collection) in Proc. R. Soc. Queensl. 62 (1952) 67, pl. 3. These sterile shoots have 3-fid leaves of which the side-lobes are minute but the central, filiform lobe up to 1½ cm long.
- 69 For *Alternanthera ficoidea* under 'Uses', read: *A. ficoidea*.
- 71a Line 19 from top of column replace '1828' by: 1824.
- 72 Fifth line of species 2. '*polyperma*' should be: *polysperma*. Further: '12' in last line from bottom should be: 20.
- 72b After '3. *Deeringia tetragyna* ROXB.' insert: Fl. Ind. 2 (1824) 512.
- 74 Under *Allmania* the volume of HOOK. Lond. J. Bot. is: 1.
- 74a The exact citation of *Allmania nodiflora* is: 1. *Allmania nodiflora* (L.) R.Br. [in WALL. Cat. (1832) 6890, *nomen nudum*] ex WIGHT in HOOK. Lond. J. Bot. 1 (1834) 226, t. 128; etc.
- 74b Insert in synonymy of '*Allmania nodiflora*': *Achyranthes nodiflora* ROXB. Fl. Ind. 2 (1824) 495;
- 75a Line 4 from top, add at the end: *nomen nudum*.

- 75a Line 7 from top, add before MOQ.: MART. Beitr. Amar. 1825 (Nova Acta Leop. 13, 1826, 287); etc.
- 75a Line 9 from top after 'MART.' replace 'ex' by: Beitr. Amar. 1825 (Nova Acta Leop. 13, 1826, 287); etc.
- 75b Add to distribution of *Allmania nodiflora*: Billiton (BECCARI).
- 76a *Amaranthus gracilis*: There is no unanimity of opinion on the correct name of this species; according to MERRILL (Amer. J. Bot. 23, 1936, 609–611) it should be called *Amaranthus viridis* L. Among LINNAEUS's citations two refer to it and two not and there is no absolute certainty that the Linnean specimen was really the basis of his description though it agrees with his description. Personally I would be inclined to follow MERRILL's carefully considered opinion which is anyhow much better substantiated than that of THELLUNG.
- 81 In the reference to *Cyathula* place: 'non LOUR.' between brackets before: BLUME.
- 81b Line 1, insert behind 'cata': DC. Hort. Monsp. (1813) 103.
- 83 Add to distr. of the genus *Pupalia*: and the Northern Territory of Australia.
- 83a Last line, omit after 'DC.': 'ex'.
- 83b Line 1, lower part of column add after '(1813)': 102.
- 84 Notes on 8. *Aerva*: the full synonymy of *Aerva persica* (BURM. f.) MERR. is: *Iresine javanica* BURM. f. Fl. Ind. (1768) 212 (sphalm.) 312, t. 60, fig. 1.—*Illecebrum javanicum* L. Syst. Veg. (ed. MURRAY), ed. 13 (1774) 206; AITON, Hort. Kew. ed. 1, 1 (1789) 289; WILLD. Sp. Pl. 1, 2 (1797) 1205.—*Achyranthes javanica* PERS. Syn. 1 (1805) 259.—*Aerva javanica* JUSS. Ann. Mus. Paris 11 (1808) 131.—*Achyranthes incana* ROXB. Fl. Ind. 2 (1824) 495.
- 84b Add to distribution of *Pupalia lappacea*: Central East Borneo: W. Kutai, Kombeng, limestone rock in low forest, Nov. 1925, ENDERT 5402; and Arnhemland (SPECHT a. 1950).
- 85b Add at the end of the references to *Aerva sanguinolenta*: ZIPP. ex SPAN. Linnaea 15 (1841) 345, nomen nudum.
- 85b Line 11 under *A. sanguinolenta* replace '509' by: 503.
- 86a Line 4–5 from top of synonymy of 1. *Nothosaerva brachiata*, substitute for '*Illecebrum brachiatum* LINNÉ, Mant. (1767) 23': *Achyranthes brachiata* LINNÉ, Mant. 1 (1767) 50.—*Illecebrum brachiatum* LINNÉ, Mant. 2 (1771) 213.
- 87a The correct authority for 1. *Centrostachys aquatica* is: (R.BR.) WALL. in ROXB. Fl. Ind. 2 (1824) 579, 497.
- 88a Line 18 from references, add after *Achyranthes argentea*: LAMK, Enc. 1 (1785) 545.
- 89a Add before 1st line from top: Malay Peninsula (rare on Cameron's Highlands, HENDERSON in litt. 1950).
- 89b Add to distr. of *Ptilotus conicus*: Sumba.
- 91 In key, species 3 should be named: *ficoidea*.
- 91a After *Alternanthera repens* (L.), omit the reference to STEUDEL. It is O. KUNTZE who made the valid transfer. STEUDEL (Nomencl. ed. 1, 1821, 34 and ed. 2, 1, 1841, 65) only listed it *pro syn.*.
- 92a The correct authority for *Alternanthera sessilis* is: (L.) DC. Cat. Hort. Monsp. (1813) 77; R.BR. ex SWEET, Hort. Suburb. Lond. (1818) 48; ROTH in R. & S. Syst., etc.
- 93a The first 4 lines of the synonymy of 3. *Alternanthera ficoidea* should be: 3. *Alternanthera ficoidea* (L.) R.BR. ex GRISEB. Fl. Br. West Ind. Isl. (1864) 67.—*Gomphrena ficoidea* LINNÉ, Sp. Pl. (1753) 225.—*Illecebrum ficoideum* LINNÉ, Sp. Pl. ed. 2 (1763) 300.—*A. ficoidea* (L.) R.BR. ex R. & S. Syst. 5 (1819) 555, non *A. ficoidea* BEAUV. Fl. Owar. 2 (1807) 66, fig. 1 *quae est A. sessilis* (L.) DC.—*Gomphrena polygonoides* LINNÉ, Sp.
- 94a The author of the basonym of *Alternanthera brasiliana* is apparently TORNER, not: 'L'. Cf. ROTHMALER in FEDDE, Rep. 50 (1940) 73. Insert in the 2nd line behind *brasiliana*: TORNER, Cent. II. Pl. (1756) 13;
- 94a Add to the synonymy of 5. *Alternanthera brasiliana*: *Psilotrichum malaccense* SUESSENGUTH, Mitt. Bot. Staatssamml. München 6 (1953) 194, *syn. nov.*
- 94a Add to the distribution of *Alternanthera philoxeroides*: Recently also found in SE. Borneo, in a swamp near the road from Bandjermasin to Martapura.
- 94b Paragraph 2, add a note at the end of *Alternanthera brasiliana*:  
Note. The specimen on which SUESSENGUTH based a new species from 'Malacca, leg. COMMERSON' consists of miserable, immature stem tips. As COMMERSON did not visit the Malay Peninsula (cf. Fl. Mal. I, 1, 1950, 113b) the specimen is certainly erroneously localized; it came probably from the New World. This is an other instance showing of how eminent importance it is to consult the records in Flora Malesiana before describing new species from Malaysia, and creating *horribilia botanica*.
- 96b Add at end of references to 2. *G. celosioides*: RAIZADA, J. Bomb. Nat. Hist. Soc. 48 (1949) 675. Add to Distr.: In 1949 this alien was collected in the N. Moluccas (Morotai).
- 96b Delete '(POIR.)' after *Gomphrena canescens*.
- 100 It was unfortunately overlooked that a sixth species had recently been rightly recorded for the Malaysian flora. This necessitates a modification of the first part of the key to the species given on page 100. We give below the new reading:  
1. Young vegetative parts and outside of perianth without an indumentum of white or pink vesicles. Undersurface of leaves with (sometimes rather indistinct) yellow glands. Stigmas 2–5. Embryo

encircling only  $1\frac{1}{2}$ - $\frac{2}{3}$  of the seed. Strongly smelling when bruised.

- 1a. Perianth-segments not or indistinctly keeled on the back. Top of ovary and fruit studded with yellow glands. Stigmas 2-5, usually 3 or more. Fruiting perianth concealing the fruit. Fruit usually horizontal, rarely vertical.

1. **Ch. ambrosioides**

- 1a. Perianth-segments in their upper half with a very conspicuous broad dorsal keel. Top of ovary and fruit glandless. Style 1, deeply bifid. Fruiting perianth appressed against the fruit but (because of their narrowness) not concealing it. Fruit always vertical. Leaves at most  $2\frac{1}{2}$  cm long, deeply dentate or pinnatisect. . . 1a. **Ch. carinatum**

1. Young vegetative parts and outside of perianth with an indumentum of white or pink vesicles. Undersurface of leaves without any yellow glands. Stigmas 2. Embryo encircling almost the entire seed. Not or faintly smelling when bruised. *Proceed sub 2 of the key on p. 100.*

- 101b Add before species 2, the following:

1a. **Chenopodium carinatum** R.Br. Prod. (1810) 407; BENTH. Fl. Austr. 5 (1870) 162; BAILEY, Queensl. Fl. pt 4 (1901) 124; ASCH. & GR. Syn. 5, 1 (1913) 91; MERR. & PERRY, J. Arn. Arb. 39 (1948) 154.—*Blitum carinatum* C. A. MEY. Fl. Alt. 1 (1829) 11; MOQ. in DC. Prod. 13, 2 (1849) 81.—*Blitum glandulosum* Moq. in DC. Prod. 13, 2 (1849) 82.—*Ch. glandulosum* (Moq.) F.v.M. Frág. 7 (1869) 11.

Annual, 10-35 cm long. Main-stem creeping at the base, higher up ascending, much branched, with ascending-erect branches, strongly smelling when bruised (same smell as *Ch. ambrosioides*). All vegetative parts rather densely clothed with shortish glandular hairs, not powdery; leaves also with many longer ordinary hairs. *Leaves* rather shortly but distinctly petioled or the highest subsessile, ovate-oblong, obtuse, coarsely obtusely dentate or subpinnatisect, usually thickish and  $\pm$  rugose,  $\frac{3}{4}$ - $2\frac{1}{2}$  cm long; highest floral leaves often very small. *Flowers* sessile, in the axils of nearly all leaves, in small, dense, subglobular clusters; clusters forming together a narrow interrupted leafy spike. *Tepals* 5, erect-incurved, narrowly oblong from a much narrowed base, acute, very concave,  $\pm 1\frac{1}{4}$  mm long, on the back, from about the middle to near the top, with a longitudinal broad,  $\pm$  triangular keel; keels with truncate tips, forming stellately spreading wings to the perianth, long-hairy. Stamen (not seen)

1. Ovary glandless; style 1, longish, deeply bifid. *Fruiting perianth* appressed against the fruit but not concealing it. *Fruit* erect, broadly oval, compressed, sharply keeled all around. Seed shining dark-brown,  $\pm$

$\frac{2}{3}$  mm diam.; pericarp inseparable; embryo encircling  $\pm$  one half of the seed.

Distr. Australia, in *Malaysia*: NE. New Guinea (vicinity of Kajabit Mission), possibly adventive rather than native in New Guinea.

Ecol. Open places, near villages, tobacco-fields, c. 550 m.

- 103b Line 2 of column under *Spinacia*, replace '*expansa* MÜRR.' by: *tetragonoides* (PALLAS) O.K.

- 104a Bottom line, insert between '5' and '111': (1799).

- 105 Reference to *Suaeda*, substitute at the end '18' by: t. 18, *nom. cons.*

- 105a Line 2, omit '(ubi?)' and insert after '192': *Halocnemum australasicum* MOQ. Chen. Mon. En. (1840) 110.

- 105a Line 3 from bottom of references of *Suaeda maritima*, insert after 'Moq.': Ann. Sc. Nat. 23 (1831) 316.

- 106a Line 4 from bottom of references to *Salsola kali*, insert after 'Moq.': Chen. Mon. En. (1840) 147.

- 106b Distr. add: Sumbawa & Aru Islands.

- 107 Read here and further for '*Aegialites*': *Aegialitis*.

- 112 First paragraph, add behind references of *Limonium*: *nom. cons.*

- 113 Recently quite some material of *Umbelliferae* has become available which was not examined by the late Dr BUWALDA. This will possibly be dealt with in a later supplement in vol. 5.

- 114 6. *Chaerifolium* in key, read: 6. *Anthriscus*.

- 116b Add to distr. of *Hydrocotyle vulgaris* in New Guinea: Wissel Lake Region, Wea delta, EYMA 4922.

- 118 13. *T. flabelliformis* in key, read: 13. *T. flabellifolia*.

- 122a The authority for 10. *Trachymene arfakensis* is: (GIBBS) BUW.

- 125b Ditto for 16. *Trachymene caerulea*: (HOOK.) GRAH.

- 126 Change in key 2nd line into:

1. Radical leaves trisect. 2. **E. moluccanum**  
Substitute for genus 6. *Chaerifolium*: 6. *Anthriscus* PERS. emend. HOFFM. Umbell. 1 (1814) 38, *nom. cons.*—*Chaerifolium* HALL. Hist. Stirp. Helv. 1 (1768) 327, *nom. rejic.*

Its only species mentioned here should be called:

1. *Anthriscus cerefolium* (L.) HOFFM. with the printed references as synonyms.

- 127a Replace the wrong provisional description by:

2. **Eryngium moluccanum** STEEN. n. sp.—**Fig. 5a.**

*Rhizoma* conspicua. *Caules* agglomerati. *Folia* basalia trisecta, chartacea, longe petiolata, superiora sensim brevius petiolata usque senilia, summa simplicia. *Capitula* pauci (2-4) flora, pedunculata, pedunculis 3-4 ex eadem axilli ortis. *Flores* ♂, nonnulli

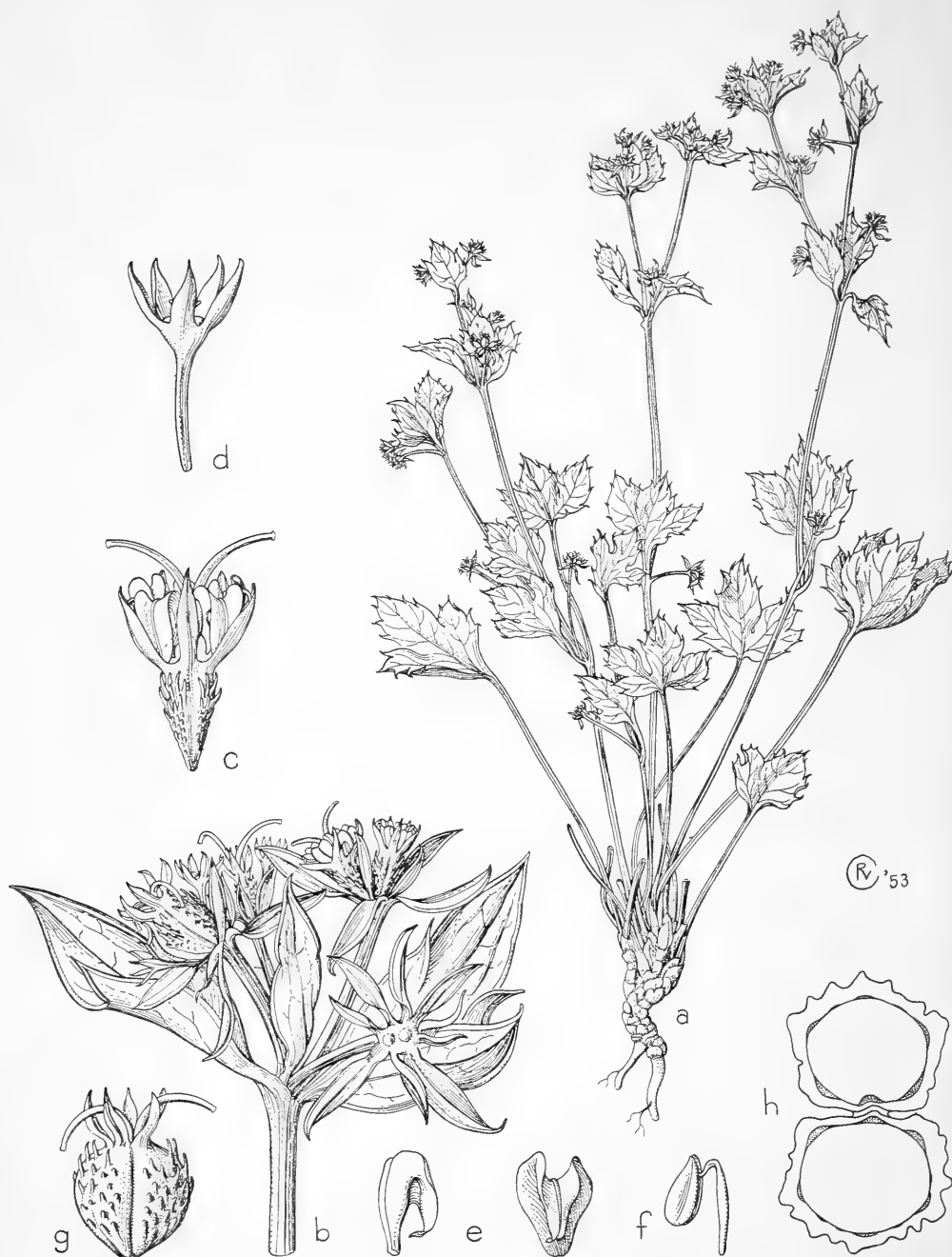


Fig. 5a. *Eryngium moluccanum* STEEN. a. Habit,  $\times \frac{2}{3}$ , b. partial inflorescence,  $\times 5$ , c. ♂ flower,  $\times 10$ , d. sterile flower,  $\times 10$ , e. petal, lateral and ventral,  $\times 13$ , f. stamen,  $\times 13$ , g. fruit,  $\times 10$ , h. fruit in section (vittae hatched,  $\times 20$  (after type)).

*imperfecti petalis organisque sexualibus ± carentes. Bracteae involucales lanceolatae, interdum spinulis 1-2 instructae. Bracteae florales integerrimae, tenuiores.*

Plant glabrous, up to 30 cm. Rootstock firm, covered by the brown withered sheath-bases. Stems tufted, erect, little branched, ribbed; lowest internode 10 cm, upper ones gradually shorter. *Leaves* green, 3-parted, the basal ones incised to  $2/3$ , cauline ones to  $1/3-1/2$ , but similar in shape and gradually somewhat smaller, the highest simple, oblong. Petiole terete, not winged, thin, that of the basal leaves up to 10 cm, higher up gradually diminishing in length to about nil; *blade* hardly subcoriaceous, when flattened suborbicular or even broader than long in outline, base broad-cuneate, sharply set off against the petiole,  $1 1/2-2 1/2$  by  $1 1/2-3$  cm; segments ovate, acute, edge with thick-margined, coarse, spiny teeth; nerves and main veins prominent, reticulations not so. *Heads* 3-4, umbellately clustered together at the nodes and apices of the stems,  $1/2-1$  cm peduncled. *Involucral bracts* lanceolate, entire or with a coarse spiny tooth on either side and a spiny tip,  $1 1/2$  by 3 mm, some more coriaceous and larger than the others. Floral bracts in the head mostly absent, in shape and texture resembling the smaller involucral bracts. *Flowers* white, 1-3 fertile and ♂, 1-2 sterile, stipitate by the linear aborted ovary. *Fertile flowers*: ovary obconical, studded with papillae which increase in size apically,  $\pm 1$  mm long. *Sepals* lanceolate,  $1 1/3$  mm long, persistent, pointed. *Petals* strongly inflexed, sulcate,  $4/5$  mm high, the inflexed half with a pointed tip and often connected with the erect half by a hymen. Stamens rose; filaments  $3/4$  mm; anthers obovate,  $2/3$  mm. Styles spreading, recurved in fruit, persistent, 2 mm. *Sterile flowers*: ovary stalk-like,  $1 3/4$  mm; sepals as in the fertile flowers; petals and sexual organs absent a reduced gynoeceum excepted. *Mericarps* separated by a narrow groove, semi-globular, the upper papillae hardened, subspinulose, in section obtusely 5-angled  $2 1/2$  by  $1 1/4$  mm; thickest vittae near the commissure, further one under each rib alternating with faint additional ones.

Distr. *Malaysia*: Moluccas (Central Ceram, G. Binaya, below 'The Gate', EYMA 2286, type BO, isotypes L, K, A).

Ecol. On rock, one specimen, c. 3000 m, fl. fr. 26 Nov. 1937.

Note. A species which cannot be placed satisfactorily with WOLFF's monograph, possibly belonging to *sect. Campestris* WOLFF. (I am not very much impressed with the natural delimitation of the sections distinguished by him.) The most aberrant feature of the new species is the depauperation of the heads, a phenomenon which,

however, is observed in several other microtherm genera represented in the Austral-Antarctic region and in New Guinea (cf. *Trachymene*, *Oreomyrrhis*). I found this also in a specimen of *Eryngium expansa* F.v.M.<sup>1</sup> (C. E. HUBBARD 3730) where there are only 6-7 flowers per head.

The depauperation gave some difficulties with the generic identification of the Ceram plant, one of the remarkable finds by my late colleague Dr EYMA, as in its heads the floral bracts—the characteristic of the genus by which it is recognized from others in the subfamily *Saniculoideae*—are absent or scarcely distinct from the involucral bracts. However, I found that the small involucral bracts correspond with the number of flowers (and therefore probably represent marginal floral bracts). In young heads there was also sometimes a bract between the flowers *inside* the row of involucral bracts, which settles that floral bracts are, essentially, present.

The affinity of this species is apparently remote. It is not at all related to the Australian ones, and nothing similar is recorded from the Subantarctic where, for plant geographical reasons, its alliance should be found. This remote status points to high antiquity and historic-plant-geographically it should be classed with *Papuzilla* and a few other chance survivors of an ancient mountain flora. It may well turn up in the highlands of New Guinea.

- 127a The authority for *Torilis japonica* is: (HOULT.) DC.  
 131b Ditto for *Apium tenuifolium*: (MOENCH.) THELL.  
 132 Ditto for *Trachyspermum ammi*: (L.) SPRAGUE and for *T. roxburghianum*: (DC.) CRAIB.  
 133 Ditto for *Cryptotaenia canadensis*: (L.) DC.  
 136 The oldest authority for the genus *Foeniculum* seems to be: BOEHM. in LUDW. Def. Gen. Pl. (1760) 344, no 852.  
 136a Line 20 from top change WOLFF into: WOLFF.  
 141 On *Tetracera* a more elaborate treatment has been published by R. D. HOOGLAND, The genus *Tetracera* in the Eastern World (Reinwardtia 2, 1953, 185-225), which formed the basis for the treatment in F.M.  
 142 In the key to the species of *Tetracera* 'back of the carpels' means the adaxial side, which is, properly, their ventral side.  
 143a Add to the synonyms of *Tetracera scandens*: *Delima tripetala* NEES & BL. in Syll. Pl. (Ratisb.) 1 (1824) 95; BLUME ex SPR. Syst. Veg. 2 (1825) 597; G. DON, Gen. Hist. 1 (1831) 71.

(1) It is quite probable that this is an early import of *E. foetidum* L. which through isolation has acquired racial character and represents a depauperate form of it; this was already hinted at by BENTHAM. Cf. this volume p. lii, § 7.

- 145a Add to the synonyms of *T. nordtiana*: *T. floribunda* DIELS, Bot. Jahrb. 57 (1922) 440. It possibly belongs to *var. moluccana* but this cannot definitely be settled since the type is lost.
- 154 A full revision of the genus *Dillenia* was published by R. D. HOOGLAND in his thesis, a pre-issued reprint from *Blumea* 7 (1952) 1-145. This formed the basis on which the treatment in F.M. was made and in which the Latin diagnoses of new species are embodied.
- 164b 19. *D. alata* has also been found by SPECHT in Arnheimsland, Northern Territory of Australia.
- 176 Line 3 of references to *Lonicera* replace at the end '10' by: 210, *nom. illeg.*
- 177a Line 11 of synonymy of 1. *Lonicera japonica*, omit: 'ZIPP. ex'.
- 180a At end of line 1 of references of *Lonicera javanica* replace '333' by: 334.
- 182 Delete in the key from the species of which flowers are unknown: *V. clemensae*.
- 182 Insert after line 6 from the top in the key: 11a. Leaves entire . . . 14. *V. clemensae* 11a. Leaves crenate-dentate.—*Proceed to 14.*
- 186b In line 3 from top the authority of *V. integrum* is: WALL. [Cat. 457, *nom. nud.*] ex DC. Prod. 4 (1830) 324.
- 189b Add to the references under *V. clemensae*: KERN, Reinw. 2 (1952) 157, fig. 10.
- 189b Add to the description of *V. clemensae* KERN: *Inflorescence* nearly sessile, up to 8 cm long and 10 cm wide, paniculate; lowest branches 2-5-nate, middle ones opposite, upper ones alternate. *Flowers* small, c. 3 mm wide. *Calyx*-limb distinctly lobed; lobes triangular, c. 1/2 mm long and wide. *Corolla* globular in bud, rotate when open, glabrous; tube very short, 1/4 mm; lobes ovate, slightly cucullate, 1 1/4 mm. Stamens exserted, much shorter than corolla-lobes; filaments inserted near base of corolla, with inflexed top in the bud-stage; anthers broadly ovate, 1/2 mm long.
- 191a Last line read: *Ebulus*, not: '*Ebulum*'.
- 191b First line from top read after Tokyo: 42 (1921) 14.
- 192a Add to distr. of *Sambucus javanica*: New Guinea (Wissel Lakes between Ginamberai to Djembodini, Febr. 1939, EYMA 4618).
- 192 First word of 5th line of references under *Carlemannia* read: Jahresber.
- 200b Omit among the references to *Kalanchoë laciniata*: *Kalanchoë acutiflora* and the citations referred to it.
- 202a Add to line 15 of the references of *Kalanchoë integra*: (ANDR.).  
Change in line 16 the year '1812' into: 1819. Add in line 17 after '728': ; SPAN. Linnaea 15 (1841) 207.
- 202b Add to distr. of *K. integra*: Sumbawa, Timor.
- 205a The authority of *Bergia ammannioides* is, correctly: HEYNE ex ROTH, Nov. Sp. Pl. (1821) 219, 402.
- 207b Line 1 from top should read: *Steris javana* LINNÉ, Mant. 1 (1767) 54.—
- 214 Add to reference of *Luzula*: *nom. cons.*
- 218a Last line of paragraph 2, insert after 'DC': ex MEISN. Pl. Vasc. Gen. 2 (1836-1843) 206.
- 231a The authority of *Phytolacca icosandra* is: LINNÉ, Syst. ed. 10 (1759) 1040.
- 232b Line 2 from bottom, change 'R.Br.' into: DC.
- 235a First line of *Piriqueta racemosa* insert after 'SWEET': Hort. Britt. ed. 1 (1827) 154;
- 236 Reference to *Turnera*, change 'ed. 2' into: ed. 5.
- 240b Add letter 'f' in fig. 2.
- 245 Under distr. of *Joinvillea* add in the 2nd line between 'the' and 'New Hebrides': Solomons,
- 256a First line of *Monochoria vaginalis* after 'PRESL': ex KUNTH, En. 4 (1843) 134; PRESL did not formally make the new combination, though he certainly intended to do so and has accordingly always been accredited by common sense with the botanical act and *eo ipso* the nomenclatural transfer.
- 267 Reference to *Mollugo*, change '463' into: 89.
- 269a Line 13 from bottom insert after *Gl. dictamnoides*: BURM. f. Fl. Ind. (1768) 113;
- 283a Line 25 from bottom, omit: '*Blatti acide*', and put the pertaining reference under *S. acida*.
- 286b Omit under 5. *Sonneratia griffithii* the reference to WATSON.
- 295 Change in note under the generic description *Hematanthera* into *Nematanthera*.
- 299 Change third word of generic references into: Pl.
- 301 Last name of legend to fig. 5, read: *D. puber* BL.
- 319a In line 21 from the top replace *var. reticulata* etc. by: *D. hispida var. hispida*.
- 332b Omit in legend of fig. 13 the last letter of the 2nd line.
- 346a Last line read: *campestre*.
- 367 First line read: Gen. Pl. ed. 5 (1754) no 59.
- 368 Change in the key:  
9. Staminodes absent.  
9a. Leaves 50-90 by 1-2 cm. Heads with numerous flowers. Anthers with 4 acute tips. Upper part of bracts with a small triangular field of small papillae . . . . . 12. *X. grandis*  
9a. Leaves 1/2-8 cm long, up to 3 mm wide. Heads with one or two flowers. Anthers with 2 obtuse tips. Upper part of bracts with a narrow elliptic field of small papillae . . . . . 17. *X. oligantha*
- 374a Add to ecol. of *Xyris indica*: According to Dr BEUMÉE (*in litt.* May 11, 1953) the local gregarious occurrence of *X. indica* in West Java is, according to the pre-war experience of the Agricultural Consultation Service,

especially connected with soils which are deficient in phosphate; this might point to development of *Xyris* in those rice-fields where rice is not under optimal conditions. Add:

17. *Xyris oligantha* STEUD. Syn. Pl. Glum. 2 (1855) 288.—*X. pauciflora* WILLD. p.p., BENTH. Fl. Austr. 7 (1878) 78; NILSSON, Kongl. Svenska Vet.-Akad. Handl. 24, 14 (1892) 36; BAILEY, Queensl. Fl. 5 (1902) 1648.

Leaves ensiform,  $1\frac{1}{2}$ –8 cm long, up to 3 mm wide, stiff, subfalcate, obtuse, glabrous except for the papillate margin; sheath 5–20 mm, membranous along the margin, provided with an up to 2 mm long obtuse ligule. Peduncle 1–12 cm by c. 1 mm, quadrangular, with 4 papillate ribs. Head subglobose to ellipsoid, 1–5 by 0.8–3 mm. Basal bracts ovate,  $1\frac{1}{2}$ –2 $\frac{1}{2}$  by 1–1 $\frac{1}{2}$  mm, acute to subacute, margin membranous with 5 complete nerves papillate in a narrow elliptic region in the upper  $\frac{2}{3}$ . Median bracts ovate, 2–4 by  $1\frac{1}{2}$ –3 $\frac{1}{2}$  mm, acute, sometimes mucronate, with one complete and 4 once forked descending nerves, papillate in a narrow elliptic region in the upper fourth. Lateral sepals  $2\frac{1}{2}$ –4 by c.  $1\frac{1}{2}$  mm, acute, crest narrow, entire. Median sepal cap-shaped,  $1\frac{1}{2}$ –2 by c. 1 mm, 1-nerved, papillate at the top. Petals 2–3 mm, limb spatulate,  $1\frac{1}{2}$ –2 $\frac{1}{2}$  by 1–2 mm, outer margin irregularly serrate, claw c.  $\frac{1}{2}$  mm. Stamens 0.4–1.2 mm, filaments 0.2–0.4 mm, anthers 0.2–0.8 mm, emarginate at the top, broadly emarginate at the base; cells with one obtuse tip, base obtuse. *Staminodes* absent. Ovary obovoid, obtuse, 3-sided, 1-celled,  $1\frac{1}{2}$ –3 $\frac{1}{2}$  by 1–1 $\frac{1}{2}$  mm. Styles  $1\frac{1}{2}$ –2 $\frac{1}{2}$  mm, 3-fid, arms  $\frac{1}{2}$ –1 mm, their top fimbriate.

Distr. N. Australia (Queensland and N. Territory), in *Malaysia*: S. Moluccas (Aru Islands: Trangan Island, between Kp. Meroor and Kp. Selarin), in coastal *Melaleuca* savannahs, BUWALDA 5534a, fl. fr. July.

Notes. Its 1–2-flowered heads, absence of staminodes, 4-angled peduncle and small size characterize this species. It has been identified sometimes with *X. pauciflora* WILLD. but differs in the entire crest of the lateral sepals, the absence of staminodes, and the two-tipped anthers.

377 First line of generic description correct: Gen. Pl. ed. 5 (1754) no 351.

378b Add to distr. map of *Drosera burmanni*: S. Moluccas (Aru Islands: P. Trangan, BUWALDA 5490, 5342).

380a Add to references of *Drosera peltata*: STEEN. Act. Bot. Neerl. 2 (1953) 304.

380b Add to localities of *Drosera peltata* in New Guinea: Lake Habbema, 3225 m, Aug. 1938, BRASS 9195; East New Guinea, plateau N of Mt Giluwe, Central Highlands, May 1951, 2200 m, SHAW MAYER.

380 Correct in first line of generic description: Gen. Pl. ed. 5 (1754) no 350.

383a Read: 1. *Octomeles sumatrana* MIQUEL.

384a Add to distr. of *Octomeles sumatrana*: Melanesia (e.g. Bougainville, WATERHOUSE 875).

384a Add to Ecol.:

I have omitted to make mention of MELCHIOR's recent article on the scales which occur on the undersurface of the leaves (Ber. Deut. Bot. Ges. 62, 1950, 72–77). MELCHIOR says that these scales have either a secretory function or one of water suction. He is in favour of the latter, and compares them with the similar absorptive scales of the Bromeliaceae (*sic*). Though this function can be admitted for the latter, the ecology of *Octomeles*, one of the fastest growing trees restricted to everwet, riverine forest, preferably on wet alluvial silt, shows that MELCHIOR's opinion is not in accordance with the ecological facts.

385 Add to references of *Tetrameles*: *Anictoclea* NIMMO in GRAH. Cat. Pl. Bombay (1839) 252.

385b Lower part, first line, add after '407': —*Anictoclea grahamiana* NIMMO in GRAH. Cat. Pl. Bombay (1839) 252.

404 In addition to the revision of *Erycibe* in the Flora Dr HOOGLAND has composed a complete enumeration (review) of the genus in *Blumea* 7 (1953) 342–361.

435b Line 13 from top, replace '(1833–1846)' by: (1838).

441b Line 9–10 from bottom, omit after 'DENNST.': the brackets and 'nom. nud. ex'.

451a Add the following note to *Merremia mammosa*:

Note. The nomenclatural basis of *M. mammosa* is not quite satisfactory as no specimen of LOUREIRO has been located and the identity of *Batatta mammosa* RUMPH. (Herb. Amb. 5: 370, t. 131) to which LOUREIRO referred is under dispute, cf. VAN OOSTSTROOM, *Blumea* 3 (1939) 346–347.

459 Paragraph 2, replace *I. plebeja* by *I. plebeia*.

481a Line 18 from top add after 'Mant.': 1.

485b For species 37. *Ipomoea crassicaulis* the correct name is *I. fistulosa* MART. ex CHOISY in DC.

According to C. A. O'DONELL (Bol. Soc. Argent. Bot. 4, 1952, 175–176) BENTHAM mentions on p. 153 of the Voy. Sulph. that he knew the contents of the Prodrômus of DE CANDOLLE; hence his work was almost certainly published posterior to it. This is in agreement with Miss TUCKER who stated that p. 134, containing *Batatas crassicaulis* Bth. Voy. Sulph., was published in 1845 and not in 1844 (cf. J. Arn. Arb. 11, 1930, 243–244).

497b Line 18 from top replace 'CLARKE' by: BENTH.

C. G. G. J. VAN STEENIS





# INDEX TO SCIENTIFIC PLANT NAMES<sup>1</sup>

compiled by

M. J. VAN STEENIS-KRUSEMAN

*Suprageneric epithets* have been entered under the family name to which they belong preceded by the indication of their rank (tribes, e.g.).

*Supraspecific epithets* have been entered under the generic name to which they belong preceded by the indication of their rank (sections, series).

*Infrageneric epithets* have been entered under the generic name to which they belong preceded by the indication of their rank.

*New names and new combinations* have been printed in **bold type**, *synonyms in italics*.

'Map' printed behind a page number denotes that a map of the concerned taxon is present on that page.

An *asterisk* behind a page number denotes the presence of a figure of the concerned taxon.

Page numbers in **bold type** denote main treatment.

Some minor printing errors in plant names have been corrected.

N.B. An index for the names of persons mentioned in the Short History of Malaysian Phytography is to be found on page clvii-clxi.

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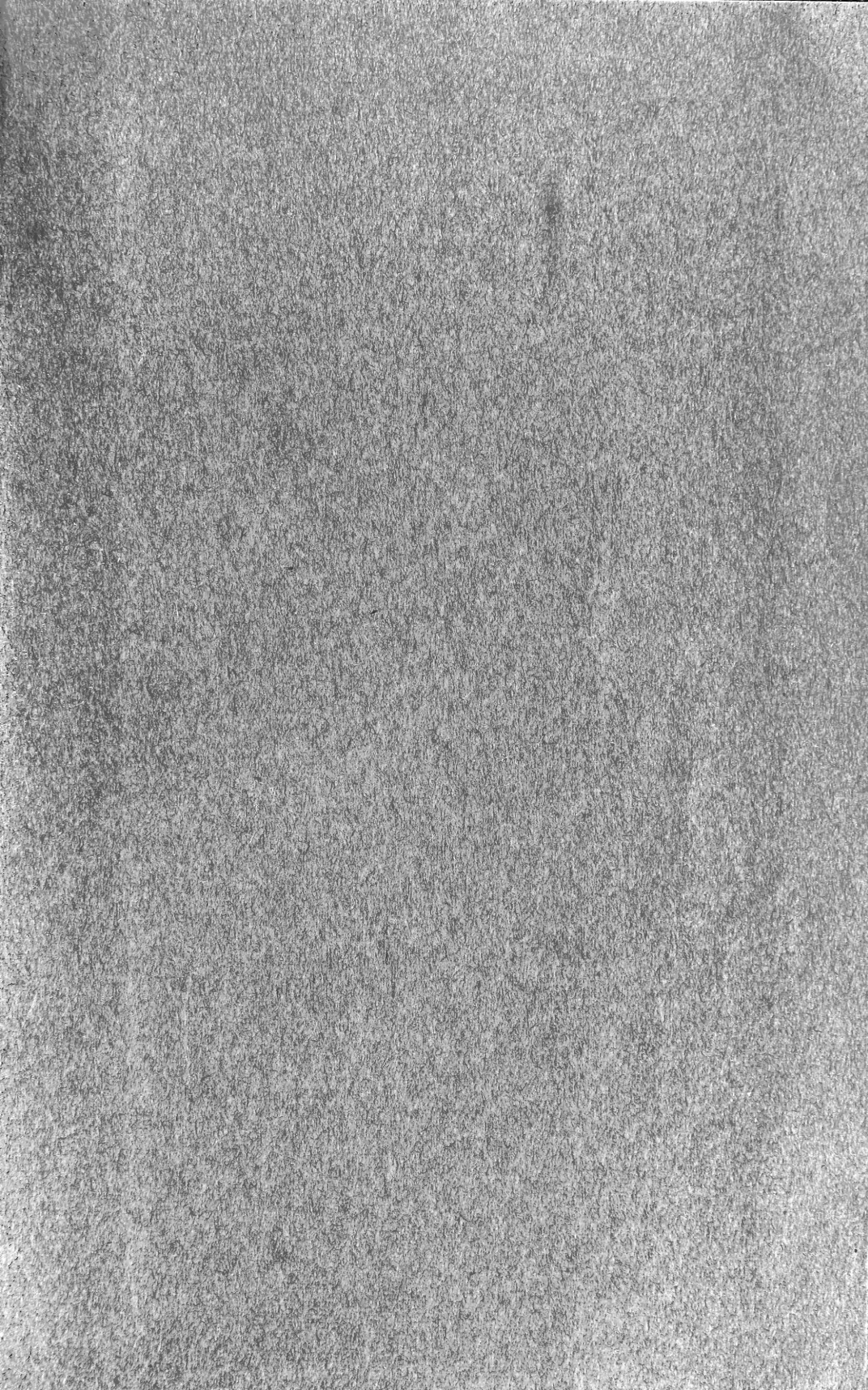
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